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THE ELECTRICAL REVIEW

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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XXII.—No. 551.

ELECTRIC STREET RAILWAYS.

IT is almost incumbent upon us to apologise for so frequently recurring to the subject of electric traction when we have nothing definite, or very little, to record in the way of achievement in our own country. But with the firm faith that this is one of the most promising spheres for the exercise of the electrical engineer's talents and skill we take the only means open to us of keeping the matter before our readers, and of reminding them that England expects every man to do his duty. It may serve as an encouragement, it may seem something like a taunt, but we cannot help once more calling attention to the good work in this direction which is being done in America. It is the Sprague Company of which we wish more particularly to write just now. We have no need to deal with the technical questions, which may or may not still be in dispute, that have arisen upon Mr. Sprague's system: lengthy correspondence has taken place through our columns between the designer of the system and English electricians, and for the present we leave our readers to form their own opinions by the light of that correspondence alone. Whatever may be said or thought with regard to the value of the Sprague motor as an invention, there can be no question as to the excellent business management with which it has been associated. The company has spared no effort to make known what it was prepared to do, and, what is perhaps of greater cogency as an argument, what it has already done. Quite a miniature library of literature relating to Sprague railways has reached us by instalments, and if this literature has been extensively circulated—as no doubt it has—in America, we can anticipate that the company will not lack work to do for the next few years. Americans are becoming thoroughly imbued with the belief that the horse is now out of date as a car motor; they are ever ready to be off with the old love and on with the new if there is a prospect, as here, of the new serving them better than the old. Romantic people may suggest that we in Old England are gifted with a greater degree of constancy. Well, constancy is in itself and in its proper place a very noble and admirable quality; but this is not a matter of romance, but one of stern, matter of fact business, and all who are concerned for England's industrial progress will desire to witness a very general renunciation of old loves in the coming time.

To get back to Sprague. We have a volume of newspaper extracts before us—extracts of papers published in different towns (cities we no doubt ought to say, but as after all we *are* in England we may perhaps be excused for following English customs), and all relating to the running of electric cars in the respective places of publication. The *Boston Evening Transcript* says: "Away with the jog-trotting old horse car!" The *Richmond Despatch* says: "It is a success! it is a revelation!" The *Carbondale Leader* says: "The electric road is a success. It is more—it is a grand success!" And other papers take up and re-echo the strain of praise. This is interesting, and satisfactory. But practical people want facts of a more definite character, and above all they want accurate statistics. We can give them these, too. The directors of the Richmond Union Passenger Railway Company say that their road is one of the most difficult, if not absolutely the most difficult, which could be met with in street railway work. There are excessive and continuous grades, and the curves are sharp and numerous. These facts, taken in conjunction with the extent of the system and the number of cars in operation, the weight of these cars and the heavy loads which they are required to carry, constitute the enterprise of equipping the line with electric motors the largest and most difficult of its character yet inaugurated in any part of the world.

The Sprague Company has carried out this enterprise with what the railway company acknowledges to be signal success. The members of the committee on construction of the Richmond Union Company have placed their satisfaction on record in the following eloquent words:—"The immediate financial success of the road has been unquestionably due in a large measure to the economy developed in the operation of your system as compared with any other method of street car propulsion. We are already contemplating an increase of equipment, and hope before the close of this year to have at least seventy of your cars in operation."

This is convincing testimony of the value of the electric system. Now for the figures. Those which we now give relate to the Richmond road. The form is that of the circular sent out by the Sprague Company:

"The total length of the track is 12 miles. Streets covered, 9 miles. Maximum grade, 10$\frac{1}{10}$th per cent. Longest grade, 5,600 feet, varying from 2 to 8 per cent. The curves are 39 in number; such as 27 foot radius with 5 per cent. grade; 40 foot radius with 8½ per cent. grade, &c. Ten miles of the road are now operated, being the heaviest part with about a mile of up grade each way. Total equipment, 40 cars. Twenty closed cars are now in operation. These cars are full-sized 16-foot closed cars. The 22-foot open cars are now being equipped.

"Note the facts for the first few weeks operation, from the following fortnightly table:

Periods.	Cars put out.	Cars per day.	Miles made.	Miles per day.
February 2—15...	118	8·4	3,874·5	276·7
„ 16—29...	158	11·3	6,625·5	473·2
March 1—15 ...	194	12·9	11,273·5	751·6
„ 16—31 ...	251	15·7	17,419·5	1,088·7
April 1—15 ...	273	18·2	21,025·	1,401·7
Total	...	...	60,218	...

Maximum run, 107 miles per day of 18 hours.

Periods.	Miles per car.	Pass.	Pass per day.
February 2—15	32·8	25,450	1,817
„ 16—29	41·9	38,437	2,746
March 1—15	58·1	49,656	2,311
„ 16—31...	69·4	67,887	4,243
April 1—15	77·	86,173	5,745
Total ...	...	267,603	...

Schedule running time, 7½ miles per hour.

"The present mileage of 1,400 to 1,500 miles on these grades would require not less than 200 horses.

"The entire operating expenses chargeable at the central station for 20 cars, with the present mileage, on the heaviest section of the track, *is only two cents per car mile.* This includes electrician, engineers, firemen, dynamo men, all coal, oil, waste, water, lighting and depreciation; the working force being, with the exception of one man, sufficient to handle 40 cars. When the 40 cars are in operation the expense will be reduced to about 1½ *cents per car mile run.*"

We place these figures before our readers, and hope they will ponder over them and set to work to emulate them, for surely after such a revelation as this the most sceptical opponent of electric traction will no longer doubt its economy. Every shareholder in every tramway company in this country ought to be made acquainted with these facts, for the interests of shareholders are not always identical with those of the directorate, and there must be many far-seeing and clear-headed men amongst them who will now insist upon knowing the reason why electricity does not take the place of horses.

WE have found that several of those estimable beings who claim to reduce the sufferings of humanity in general to a minimum, by dispensing so-called magneto and electro-medical appliances to all in search of health, have regular contracts with certain newsagents for the insertion of their sometimes gross and filthy advertisements between the pages of all periodicals sold by them. One London agent, whom we interviewed on the subject, has promised that the contents of the ELECTRICAL REVIEW shall not again be disfigured so far as he is personally concerned; but unless he takes special pains to remove our Journal beyond the reach of his assistants, we cannot see that his promise will avail us much. Our subscribers could help us and themselves by either procuring the REVIEW direct from this office, or by refusing to accept from their newsvendors copies containing the objectionable insertion. These latter, finding trade falling off, would procure the REVIEW through other agents who did not stoop to traffic with such discreditable associates.

IT may interest Mr. Addenbrooke to learn that some years ago we made a series of tests for the late Robert Sabine upon some lengths of submarine cable for the purpose of making a curve of electrification for 1, 2, 3, 4, 5 ... *n* seconds charge. We have not a copy of the results obtained, neither do we know whether the original MS. will ever be forthcoming, but it can easily be understood that the rush of current during the first second makes it appear that the insulation of the cable is of the very slightest, the effect being more nearly as if the far end of the cable had been earthed. These experiments, we may add, were made at the works of Messrs. Henley & Co., and we think that Mr. Addenbrooke, or any other gentleman with the necessary time at his command, might throw much light upon the phenomenon of the electrification of insulating materials by a repetition of the tests.

MR. D'HUMY is irrepressible! His latest move is "the D'Humy cabinet battery." The object of the invention is said to be closely connected with domestic electric lighting, but in which portion of one's establishment is the apparatus to be placed? That is the question. The name is suggestive enough, especially when coupled with its French origin, and the battery itself, well—we know it has been loudly praised for its disinfecting properties, and this is perhaps a point in its favour under certain conditions. The capital of the syndicate is a large one considering the purpose in view; indeed, we should think it considerably too much for even a company floated to exploit such a cell as a "cabinet" battery.

THE Westinghouse Machine Company, of Pittsburgh, Pa., U.S.A., has recently effected considerable improvements in its new automatic compound single-acting steam engines, both condensing and non-condensing. The results thus far obtained are said to be very surprising, and tests are still in progress. In the ordinary Westinghouse automatic engines (of which over 3,000 are now in use) the principal points which seem to have won public favour may be briefly stated as follows:—1st. The complete avoidance of the effects of lost motion on all reciprocating parts by the self-compensation of the single-acting principle. 2nd. A high enough initial speed to admit of the engine transmitting its entire power, through direct connection, to the work to be done. 3rd. A complete automatic lubrication of every part. 4th. An automatic governor so lubricated constantly that the standard rate of speed is maintained on each and every stroke of the engine, instead of maintaining an average rate of speed. 5th. Through high speed (forbidden in double-acting engines) less weight per horse-power, less loss through internal condensation, less space occupied, and less cost to the buyer. 6th. The ability to procure repairs immediately, at any time, from a complete stock always on hand at Pittsburgh, instead of having to await their manufacture, after a break has occurred. 7th. A minimum cost for repairs, these parts being made in large quantities and sold at cost. In designing the new engines the aim has been to cover all the features now so popular in the automatic engines, and to add the following points, which were considered desirable:—1st. To obtain the recognised economies in fuel, to be had through compounding, without any complication or excessive cost, so that these engines can be placed on the market, in the strictly commercial sense, from the smallest size to the largest. 2nd. Practically no more complication or mechanism than exists in the simplest engine. 3rd. A greater economy of fuel than heretofore obtained by anyone in engines of equal horse-power. 4th. A complete and perfect control of the steam supply to both high and low pressure cylinders, through the medium of a single balanced valve. 5th. The ability to maintain an absolutely constant speed under varying steam pressures and loads. 6th. The best results throughout, combined with the greatest simplicity and the least cost.

THE *Annales Télégraphiques*, in its issue of November-December, 1887, contains an interesting article on the employment of copper wire for overhead lines. After giving a *resumé* of Mr. Preece's paper on this subject, read at Manchester in September, 1887, the author proceeds to describe at some length the principal features connected with the employment of this wire on overhead lines in France for long-distance telegraphy. The question of the coefficients of safety with the corresponding strains, spans, sag, and temperatures, is fully discussed, and the conclusion is arrived at, in comparing the methods adopted in France and England, that although some slight differences may exist in the details of construction, the mechanical and electrical qualities necessary in this class of conductor are the same. Want of space prevents our dealing more fully with the scientific portion of the article referred to, but we extract from it the following particulars:— The wire generally used is silicious bronze, the sizes adopted being of 2 mm., 2·5 mm., and 3 mm., these gauges corresponding respectively with the English of 2 mm., 2·46 mm., and 2·84 mm. It is remarked that these differences show that the metric system is not yet adopted in England. The specification for this wire stipulates that its conductivity must not be less than 96 per cent. of pure copper, the breaking strain not less than 45 kilogrammes (99·207 lbs.) per square millimetre, and the elongation at the moment of breaking not to exceed 1 per cent. The wire should bear bending to a right angle, alternately backwards and forwards, eight times without breaking. On a line recently erected between Orleans and La Palisse the conductivity of the wire varied from 96·5 to 99 per cent. of pure copper, and the following mean resistances are given :—

Gauge. mm.	Resistance at 0° C. ohms.	Resistance at 10° C. ohms.	Resistance at 20° C. ohms.
2·5	3·3	3·46	3·60
2·0	5·11	5·31	5·52

SOME curiosities in letter writing relating to the galvanic belt fraternity have fallen into our hands during the past week. We say relating to the "galvanic belt" fraternity, although one set of letters has reference to the British Association of Medical Electricians, for the reason that we believe that association to comprise, not the whole, or more than one, of the belt advertising community, but a certain individual notorious in the galvanic belt connection and possibly a few of his friends or employés. Recently our columns contained an announcement of the registration of the British Association of Medical Electricians, "Limited," and prominent amongst the names of subscribers was that of Mr. C. B. Harness. Shortly after a paragraph appeared in the daily papers announcing that the Belgian National Society had conferred the Cross of Merit upon Mr. Harness, who had also been elected President of the British Association of Medical Electricians. A friend of ours, anxious to know more of the Association of Medical Electricians, wrote to the offices of the association in Hatton Garden for information. The reply was curious. Here is a copy:

> The British Association of Medical Electricians.
> Registered Office :—39, Hatton Garden.
> London, E.C., *4th June*, 1888.
>
> Dear Sir,—Before replying fully to your favour of the 31st ult., I must ask you to kindly let me know your profession, and for what purpose you require the information asked for.
>
> Yours faithfully,
> H. C. R. SHARMAN, *Secretary*.

To this cautious communication our friend returned answer that he was in the electrical profession and had studied the subjects of magnetism and electricity as applied to the human body to some extent, and was desirous of continuing the study in some society where such subjects were made special features. The reply to this is strongly suggestive of the confidence trick.

> The British Association of Medical Electricians.
> Registered Office :—39, Hatton Garden.
> London, E.C., *7th June*, 1888.
>
> Dear Sir,—In reply to your favour of yesterday, I beg to inform you that you can obtain from me a printed copy of the by-laws and articles of association by remitting 10s. 6d. to the above address.
>
> Yours faithfully,
> H. C. R. SHARMAN, *Secretary*.

Needless to say, our friend did not remit 10s. 6d. for the doubtful privilege of perusing the by-laws and articles of association of this most recent of Mr. Harness's advertising agencies.

THE other matter is equally instructive, although slightly different in character. Another friend wrote to another "medico-electric belt" advertiser, merely asking for price list and particulars of their apparatus. In response came a *lithographed* letter, of which the following is a copy :—

> Sir,—I received a letter from you a short time since, and after carefully considering the symptoms described therein, advised you as to the appliances and treatment best adapted for your speedy relief and ultimate cure. Not having had a reply, I am induced to think that perhaps the expense of the appliances recommended is greater than you care to incur. Kindly send me a line if this be so, and I will endeavour to make the terms such as shall meet with your approval. It is of course to my interest to supply you, irrespective of cost, with an appliance which will cure you, knowing that eventually I shall be rewarded by your grateful recommendation. Awaiting your favour,
>
> I am, yours faithfully,
> W. G. JOHNSON.
>
> The Medico-Electric Belt, Truss and Battery
> Company, Limited, 58, New Bond Street, W.

There is little need for comment upon humbug of so patent a kind. The marvel is that anybody in the world is ever taken in by it; but the dupes must be numerous, or the extensive advertising system which prevails in connection with it could not be maintained.

IN our next issue we hope to give full particulars of a series of tests made with the primary battery of which we spoke last week. We believe that with a properly constructed Bunsen element in which the plates are well amalgamated the consumption of zinc should not be greatly in excess of the theoretical equivalent, but as a rule the local action is very considerable, and the constancy of current limited to a few hours. In the improved type of this cell which has been submitted to us we find the nearest approach to Prof. Silvanus Thompson's ideal of a primary battery, and we make bold to think that he will agree with us upon seeing the data obtained. But after all how insignificant is a galvanic source of electrical energy compared with the dynamo, and how disproportionate the cost per horse-power! The feeling becomes all the more appreciable when watching hour by hour the performance of a comparatively bulky primary battery whose output is only 60 watts, or about the amount of electrical energy consumed in one 16 candle-power incandescent lamp. Still galvanic elements have their special field of operations, which is not by any means so small as may at first sight appear, and so long as they are kept within their legitimate sphere we are always pleased to chronicle any real improvement which may be conducive to their greater usefulness.

TAYLOR'S GALVANOMETER.

THIS galvanometer, designed by Mr. Herbert A. Taylor, of the well-known firm of Clark Forde & Taylor, has been designed more particularly for testing submarine telegraph cables, and it has for its principal object to provide apparatus and arrangements which are more efficient in action than those hitherto constructed or arranged.

Figs. 1 and 2 are vertical sections at right angles to each other, illustrating one arrangement of the new galvanometer. Fig. 3 is a plan with the cover removed, and fig. 4 is a horizontal section taken on the line 1, 2, fig. 2.

A number of magnets, A, are arranged one above another on a table or platform, B, one arm or pole, A^2, of each magnet being longer than the other arm or pole, A^3, and the long arms being magnetised with one polarity and the short arms with the opposite polarity. At the side of this set of magnets is placed another set of similar magnets, C, but with the long and short arms, C^2, C^3, respectively magnetised with polarities opposite to the polarities of the long and short arms respectively of the first set. The two sets of magnets, A and C, are arranged together so that the short poles of each set are in proximity to each other but at a short distance apart. At the bottom and the top of the two sets of magnets, A and C, is placed a single horseshoe magnet, D, having poles of the same denomination as the correspondingly situated poles formed by the long arms of the two sets of magnets, A and C. The whole of these magnets are secured to the base, B, by bolts, A^4, extending from the base up between the arms of the magnets and through holes in a bar, A^5, placed across the arms of the top magnet, and forced down thereonto by nuts, a^2. The spaces between the magnets may be filled in with brass or other non-magnetic material. Plates or pieces of soft iron, E, of a convex shape are attached to the short arms of the magnets, and pieces, D^1, D^1, of soft iron and of a concave shape are fitted to the inner sides of the long arms of the magnets, the concavities of the last named pieces being presented towards the pieces, E, on the short arms. One or both of the curved pieces, D^1, may be made movable, for enabling the coil, F, of insulated wire to be removed. One of the pieces, D^1, is removable by there being formed on it a dovetail projection, c, sliding into a corresponding dovetail guide, c^2, attached to the magnets. Between the pieces of soft iron, E and D^1, is a space in which the coil, F, is suspended so as to be capable of moving freely, and it is provided with means for indicating the movements, which may be magnified and thrown on to a scale. The curved form of the pole pieces gives a very uniform field in which the coil moves. The base, B, to which the sets of magnets, A, C and D, are secured is composed of insulating material to which are fitted pillars, H, carrying the coil suspending and adjusting portion of the apparatus, which may consist of two hinged arms, I, I, fitted with screw clamps, K, for connecting the suspension wires, L, of the coil. The hinged arms, I, are supported by a piece, M, capable of moving

Fig. 1

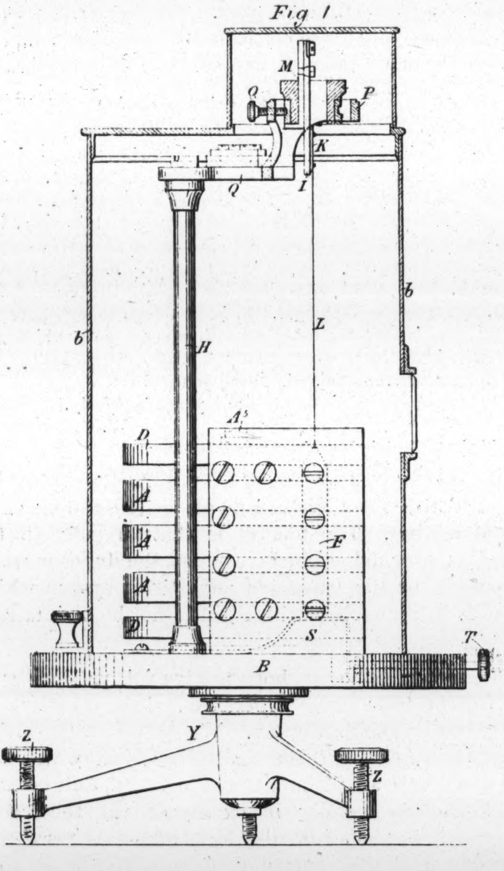


Fig. 2.

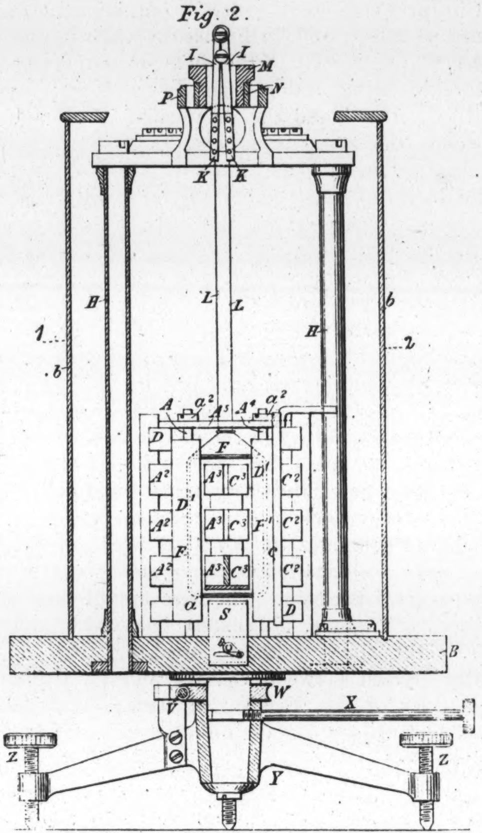
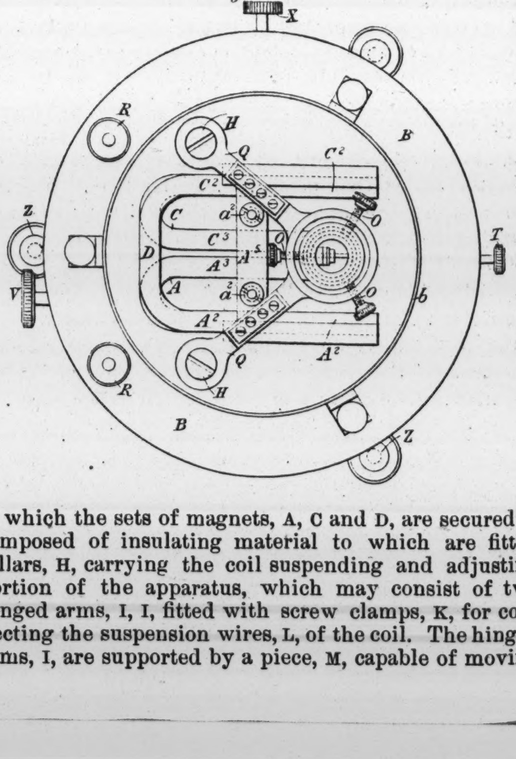


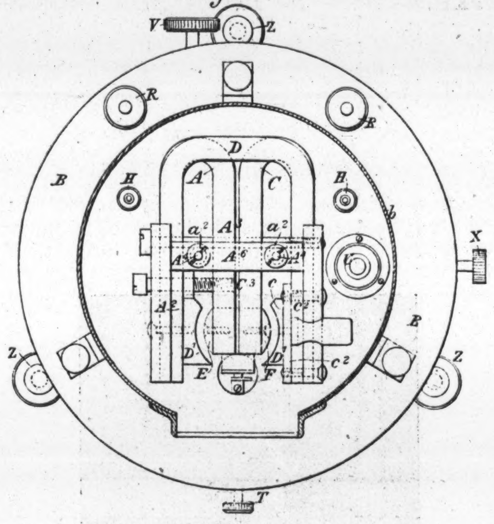
Fig. 3.



in a collar piece, N, held by suspending and adjusting screws, O, passed through a ring, P, attached to the pillars, H, by the arms, Q. The pillars, H, may be made hollow for the connecting wires to pass through, they being connected to the arms, Q, and to binding screws, R, on the base, B, the circuits being completed in the usual or in any suitable manner.

To prevent the coil, F, from being damaged when the instrument is moved from place to place a spring, S, is arranged immediately under the coil, this spring being moved by a thumb screw, T, projecting from the side of the base, B, so that the spring may be brought into position to support the coil, F. The base, B, is provided with a level, U, and under the base is arranged a tangent adjusting screw, V, and worm wheel, W, to the boss of which latter is applied a locking screw, X, which when unscrewed allows the instrument to be moved round freely on the tripod, Y, without interfering with the tangent screw. The whole is supported on the tripod, Y, the feet of which are fitted with adjusting screws, Z, for the purpose of levelling the apparatus. A piece of soft metal, *a* (fig. 2), such as leather for example, is provided beneath the inner pole pieces to prevent the coil from being injured when it is raised. The whole mechanism is enclosed in a casing, *b*, to protect it from injury.

Fig. 4.



The arrangement of the circuit of the instrument is illustrated diagrammatically in fig. 5. It consists of two resistances connecting three terminals, *k*, *l*, and *m*, and the wires of the coil, F, are connected respectively to two of these terminals, *k* and *l*, so that they include in a parallel circuit one of the resistances, *h*, which acts as a shunt, and is adjusted to give the required "damping" when the instrument is on open circuit. This resistance is conveniently made about one and a half times as great as the resistance of the suspended coil. The other resistance, *i*, is several times greater than that of the suspended coil, and serves the purpose of preventing over damping when the resistance aforesaid is short circuited (which may be effected by the plug or key, P), which is necessary in taking an insulation test of a submarine cable by direct deflection. The instrument can be put in circuit to include one only of the resistances, or both of them, as may be most convenient for the observation to be made. Where the sheathing of the coil is by a helically wound strip, or where the idle wire is used, the damping is effected by the metal frame and sheathing, and can thus be made more or less independent of the resistance in circuit with the coil, so that the additional resistances can in this case be dispensed with.

In the apparatus set up as explained the indications are given with precision and rapidity, obviating much of the uncertainty attaching to instruments or apparatus as usually arranged.

ON THE INSTALLATION, COST OF WORKING, AND RETURNS OF CENTRAL STATIONS FOR ELECTRIC LIGHTING.

By W. FRITSCHE (of the firm of Fritsche and Pischon, Berlin).

(*Continued from page* 616.)

FOR the certain and regular production of electric energy, the motors must work with the greatest evenness. Very essential is the condition that the regulation of the motors is accurate. The consumption of gas or of steam must always bear a favourable proportion to the work to be done at the time being. In the management of central stations, the motors only occasionally work at a maximum strain; they must therefore above all things work satisfactorily for a medium duty.

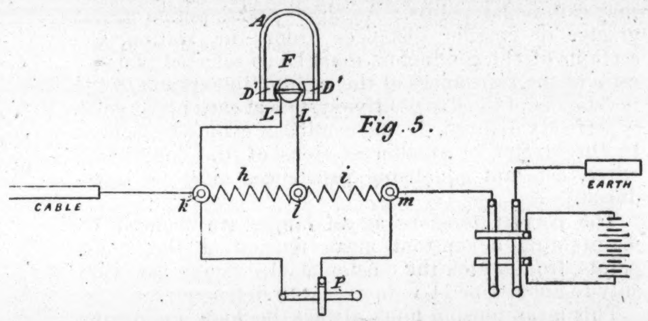


Fig. 5.

The gas motor fulfils these demands less perfectly than the steam engine, so that it will scarcely come into general use, especially as the high price of gas stands in the way.

The future importance of gas motors for central stations is not however to be denied, as they may be improved so as to meet the most rigorous demands. The limits which at present exist in respect of size may also be got over.

For the production of very strong currents of low tension full scope is given by the modern construction of steam engines and of large dynamos. The necessity of producing electric energy in large quantities has led to the construction of dynamos which run slowly, and steam engines have been modified accordingly. The evenness of movement, the capability of regulation, and the economy in the consumption of steam have been carried out to a desirable degree in large steam engines. Such engines can be constructed of any required power, so that in this respect there is no difficulty in the arrangement of central stations.

In order to meet the gradually increasing and decreasing consumption of the current, and to have a sufficient reserve, several machines are always needful, their size varying according to local circumstances and the extent of the installation.

We will now consider the factors which are decisive in the distribution of electric energy.

Within the entire district of a central station there must be at all times light available for every individual consumer without interfering with other consumers. This minimum demand, which gas-lighting was at once able to meet, can be easily reached by the electric light in parallel. If all the lamps, whether glow or arc lamps, are arranged in parallel circuits, each lamp can at pleasure be set in action or extinguished, without interfering with any other lamp, always supposing that the conductors are so arranged that the tension shall be adequate to the varying consumption. The entire conducting system must, notwithstanding the fluctuations of the demand, maintain a practically constant tension. It must therefore be possible at any moment to regulate the tension at certain points, and bring it to its proper standard by raising or lowering the activity of the machines.

Starting on this programme, the author has further developed the bi-conductor system, so that with an accurate method of measuring tensions at certain points of the conductors, and with a correct selection of the distributive and conductive appliances the most extreme demands may be met.

Practice has shown that a glow light of steady brilliancy can be secured only by keeping the fluctuations of tension below 1½ v.

If it is required to supply an extensive urban district with the electric light, it is necessary to lay down one or more distribution nets, more or less ramified, to which the conductors for the houses are attached. According to the work which is likely to be thrown upon such a net, it must receive a more or less abundant supply of current from the central station. In feeding the distribution net care must be taken that the fluctuations of tension do not exceed the above limits. From the terminal boards at the central station to which the dynamos are connected, positive and negative conducting wires lead to suitable points of the net, which we may call nodal points. As these nodal points are at greater or smaller distances from the station, the sections of the conductors must be so selected that the ratio of the resistances of the conducting system to the resistances of the distributive system at each nodal point is perfectly definite. If this condition cannot be secured by the greater or smaller sections of the conducting wires, constant equalising resistances must be introduced.

The correct tensions at all lamps are secured by maintaining a constant mean tension at the nodal points, from which the tension at the lamps can vary only to about 1 or 1½ v. in excess or deficiency.

This mean tension must always be kept up during action, and for this purpose tension wires lead back from all nodal points to the station.

According to the greater or smaller consumption of current in the conductive net there arises a tendency to a decrease or an increase of the mean tension at the nodal points, which is always lower than the tension at the machines. To counteract this tendency and to keep the mean tension constant, that at the machines must be modified. The machine tension must therefore never be constant, but must be equal to the normal tension at the nodal points *plus* the decline of tension in the conductors, or equal to the tension at the lamps *plus* the loss of tension in the conductive and distributive circuits.

For instance, if 2,000 a. are consumed in the system of distribution, and if the loss of tension there is 1·5 v., and in the positive and negative conductors (from the station to the nodal points) 15 v., the tension at the machine, if the lamps are to burn at 100 v., must be $E_m = 100 + 15 + 1{\cdot}5 = 116{\cdot}5$ volts.

This tension at the machine must be reduced in case of a reduced consumption of the current in order that the mean tension does not become too high.

The exact regulation of the mean tension by means of tension wires carried back to the station is very important in practice. The author has therefore proposed and successfully carried out the following method.

From the positive nodal points measuring wires, all having the same resistance, lead back to the station where they are united at a terminal board. From this plate a wire passes through a voltmeter to a second board, where the wires come together which lead from the negative nodal points. By this arrangement all the tensions which prevail at the different points of connection are summed up, and the voltmeter indicates the mean tension.

The centres of gravity, so to speak, of the development of the bi-conductor system, lies in the possibility of thus controlling the mean tension at the nodal points, as above described, the distributive net being equably supplied.

The special arrangement of the distributive conductors depends on local circumstances. The circuits form rings, concentric or intersecting, which are divided into single segments by the nodal points, or they form a complete net, some of whose nodal points are developed as main nodal points and connected with the central station by the positive or negative conductors.

Having thus given a general explanation of the production and distribution of electric energy we will carry out in detail the solution of the problem in an individual case, paying especial attention to its financial aspect.

Let a central station be built for a district of a town of a diameter of about 1,000 metres. Let the net of conductors to be laid down in the streets of this district suffice for a usefully available energy of 360,000 watts.

(*To be continued.*)

EXPERIMENTS ON INDUCTION COILS.—II.

By Dr. LOUIS DUNCAN, CARY T. HUTCHINSON, and GILBERT WILKES, Johns Hopkins University, in the *Electrical World*.

(*Continued from page* 473.)

CONSTANTS OF APPARATUS.

Dynamo.—This was of the Siemens alternating type. It had eight field magnets and eight coils in the armature. At about 800 revolutions it gave approximately 50 complete alternations per second. The following are the constants :—

Resistance of armature	7·00 ohms.
Resistance of field	1·40 „
Self-induction of armature removed from machine	$\cdot082 \times 10^9$

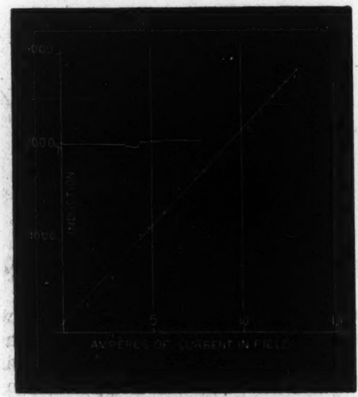


FIG. 1.

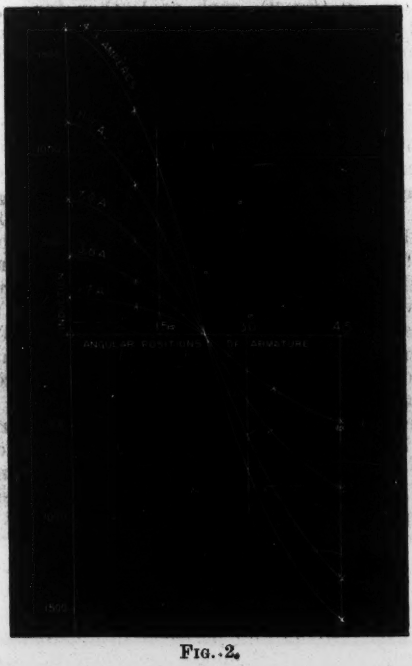


FIG. 2.

Self-induction of armature in position was as follows:—

Current in field.	Angular position of armature with respect to poles of field magnets.		
	0°	11¼°	22½°
0 amp.	·120 × 10^9	·112 × 10^9	·100 × 10^9
2·5 „	·125 × 10^9	·115 × 10^9	·108 × 10^9
4·5 „	·128 × 10^9	·115 × 10^9	? ·106 × 10^9

Mutual induction of armature and field:—

Angular positions … …	0°	11¼°	22½°
Mutual induction … …	·092 × 10^9	·062 × 10^9	·003 × 10^9
Self-induction of field … … … …			2·50 × 10^9

Induction coils.

Resistance of primary of induction coil, A …	4·40 ohms.
„ „ secondary of induction coil, A …	1350 „
Self-induction of primary of induction coil, A …	·65 × 10^9
„ „ „ secondary of induction coil, A…	132 × 10^9
Mutual induction of primary and secondary …	8·1 × 10^9
Resistance of primary of transformer, A′ …	50·0 ohms.
„ „ secondary of „ „ …	0·100 „
Self-induction of primary of „ „ …	1·96 × 10^9
„ „ „ secondary of „ „ …	·0047 × 10^9
Mutual induction of primary and secondary …	·098 × 10^9

Condenser.

Capacity … … … … … … 4·72 microfarads.

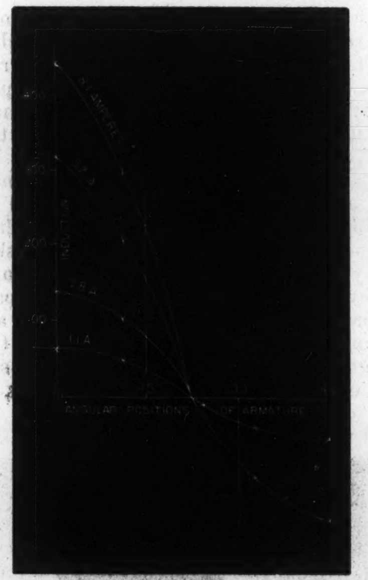


FIG. 2A.

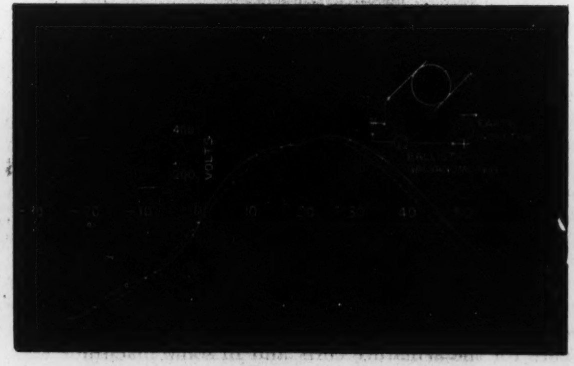


FIG. 3.

The curves given in this paper represent mainly the differences of potential between designated points on the circuit; with each curve is shown a diagram of the connections used. The broken curve is a simple sine curve drawn to cross the axis with the observed curve and with the same maximum ordinate:—

Experiment 1. Fig. 1 gives the induction through the field magnets in absolute units for different currents. The large air space between the poles causes the result to be similar to that obtained from a short, thick magnet; it is approximately a straight line.

Experiment 2. Figs. 2 and 2*a*.—The curves of these figures represent the induction through the small and large test coils on the armature. A few observations only were taken for each curve, so that they are possibly not very accurate.

FIG. 4.

Experiment 3. Fig. 3 gives the rate of change of induction in different points of the field. It was obtained by connecting the armature coils with a ballastic galvanometer through a pointer making contact with the armature circuit through an arc of 3°. The position of the pointer was changed for each observation and the armature given a quick turn. It was extremely difficult to get contact for exactly 3° each time, and it seems probable that there may have been slight errors.

FIG. 5.

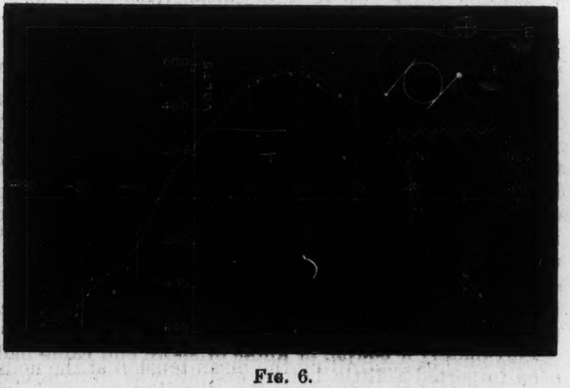


FIG. 6.

Experiment 4. Fig. 4 gives the curve of E.M.F. at the terminals of the dynamo on open circuit, full current and half current being used in the field.

Experiment 5. Fig. 5.—The conditions are the same as in fig. 1, excepting that a condenser is introduced in the circuit.

Experiment 6. Fig. 6.—The induction coil was in the circuit, the secondary being open; the differences of potential were taken at the dynamo terminals.

Fig. 7.

Experiment 7. Fig. 7.—The conditions are the same as in fig. 6, excepting that the secondary was short circuited.

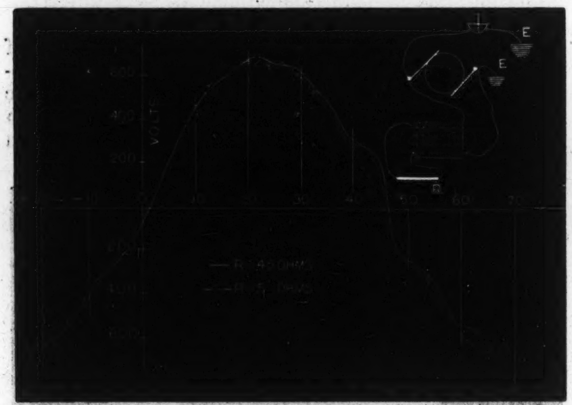


Fig. 8.

Experiment 8. Fig. 8.—The potentials were taken at the dynamo terminals with the primary of the transformer in the circuit; the resistances in the secondary were 45 ohms and 5 ohms respectively. The curves obtained were very much alike.

(*To be continued.*)

DEMERARA RIVER CABLE.

[A COMMUNICATION.]

The cable across the river Demerara forms a very important link in the telegraphic system of the Colony of British Guiana, as when it is out of order the county of Essiquibo is cut off from Georgetown, the seat of Government. In order to be as free as possible from liability to damage by anchors, &c., instead of crossing direct, the line is carried some ten miles up the East side of the river bank, and the cross is made with nearly a mile of cable. Early in the month of April signals suddenly failed, and the tests of the electrician soon confirmed the worst fears. The cable was gone, possibly at one of the seven splices known to be in it.

Fortunately a couple of knots of shore end cable had been imported a little before, and it was determined to lay not only one, but two new ones, there being a special reason for so doing. Accordingly, punts were hired, cable coiled, tug hired, and Georgetown was left behind, just before noon, on a very hot day. The steaming was quickly accomplished, and one end of the cable taken up a tiny creek, so as to have it well ashore. Connection was made with the land line on the eastern side, and the order given to go slow ahead for the Western bank. In due course that was reached, but a falling tide prevented further progress, so a light copper wire was carried ashore, having a long spiral in it, and communication was established temporarily the same afternoon. Speaking had been kept up on board as a rough test of all going right. With the early morning the cables were got ashore, permanently connected, and well buried before the state of the tide enabled an easy straight course to be run for the other side. That, however, was, when begun, very speedily accomplished, and the end taken ashore, by the side of its fellow. The return journey down the river was commenced, when the curious fact was noticed that Mr. Vyle, the electrician, was the only European engaged in the work, the intelligent captain of the tug, puntmen, and labourers being all "coloured genelmen;" but if that electrician's face was not black, there was no doubt whatever that his white suit of the day before was undoubtedly so.

NEW ALTERNATING DYNAMOS.

By R. KENNEDY.

(*Continued from page* 619.)

Fig. 7 is a complete view of the Hopkinson-Muirhead dynamo, the armature for which was described in last issue. The field magnets are made up of wrought iron cores fixed to cast iron framework, the poles being alternately N and S all round each side and opposite poles facing each other. The question as to whether the armature or the field magnet should be the revolving part of a dynamo can be settled only by considering a few circumstances connected with the manufacture and maintenance of the particular machine under consideration; mechanically considered we should say that the lighter part of the dynamo should be the revolving part, while the heavier part should be stationary. The heavy part of an alternating dynamo must be the field magnets; in fact the greater the strength of the magnetic field and the smaller the magnetic effect of the armature the better, so that in all good dynamos the armature must be very light compared with the field magnet.

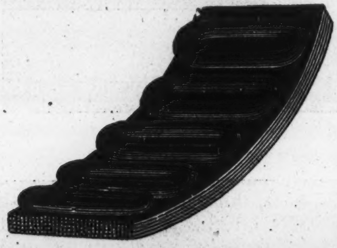


Fig. 6.

In the Mordey dynamo, and in the author's dynamo previously referred to, the armature will not weigh more than one-eight part of the weight of the field magnet, so that supposing the field magnet to weigh 16 cwt., the armature would weigh about 2 cwt.; now, the speed must be the same, say 650 revolutions per minute, whether the 16 cwt. piece or the 2 cwt. piece is the revolving part; that being the case no engineer would think of revolving the heavier part but for other considerations. In machines without an iron core for the armature coils and in some machines with iron cores in the armature, it is exceedingly difficult to fix and mount the armature coils securely, and at the same time ensure good insulation, so that they may be rapidly revolved with safety. In some earlier machines great mechanical skill is displayed in mounting armature coils on a shaft, and they have been fairly successful with small machines at moderate speeds, yet there is a feeling of distrust in such mountings, and for large dynamos for heavy work they have been discarded.

The class of magnet in the Mordey dynamo does not easily admit a revolving armature, and further, the class of armature employed is exceedingly difficult to mount on a spindle so that it may be rapidly revolved; these are two good reasons why the heavier part is revolved in this machine.

In the author's dynamo the magnet easily admits a revolving armature, and the armature having a strong iron core mounted as a rim on a pulley can be revolved with perfect safety, and hence the lighter part is revolved in this machine.

The same considerations leads up to all the difference in construction between the Zipernowski dynamo and the Westinghouse dynamo; both machines have drum armatures and field magnets having radial poles of alternately opposite polarity.

In Zipernowski's dynamo the armature is a fixed drum of large diameter; on the inside of this drum is laid a number of coils of insulated wire corresponding in number to the poles on the field magnet. Fig. 6 shows a section of the Zipernowski armature with a few coils laid in place.

In Westinghouse's dynamo the armature is a drum of small diameter, and is mounted on a shaft to be revolved rapidly; on the outside of this drum is laid a number of coils corresponding in number to the poles on the field magnets.

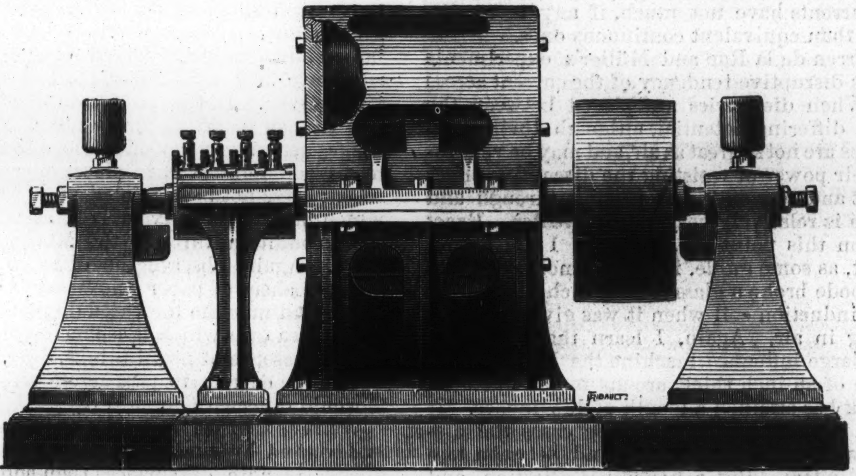


FIG. 7.

The field magnet in Zipernowski's dynamo is mounted on a shaft and revolves inside of the armature, the radial poles projecting outwards towards the coils on the inside of the armature. The field magnet in the Westinghouse is fixed, and the armature is revolved inside of it, the radial poles projecting inwards towards the coils on the outside of the drum. One result of this difference in construction is that the Westinghouse machine can be driven at a speed of 1,600 revolutions per minute, while the Zipernowski is limited to about half that speed, so that with equally powerful field magnets the Westinghouse should be much nearer self-regulation than the Zipernowski, as half the length of armature conductor will give the same E.M.F., the speed being double at the periphery.

The alternating dynamo is at present undergoing the same process of evolution through which the continuous current dynamo has passed during the last four or five years, and there can be no doubt that ultimately a simple and effective form of machine will be almost universally adapted.

It is somewhat amusing to go over a few scores of specifications and drawings of continuous current dynamos, in which magnets and armatures of wonderful shapes, forms and dispositions are described, and to find after all that nothing has proved better in such dynamos than the oldest form of magnet, namely, a simple horseshoe magnet with the ordinary Gramme ring or Alteneck drum armature.

Novelty in design in dynamos does not count for anything; novel designs must be accompanied by sound mechanical and electrical reasons to justify their adoption, but seldom is this the case; novel designs are more often adopted simply because they enable the designer either to evade somebody's claim, or to enable him to set up claims of his own, the result being that many years are required to bring forth out of all the designs, that one which combines the greatest number of good points in one machine.

The alternating dynamos at present known and advocated by different designers, may be known by the following list of features:—

Armature with iron core.
Armature without iron core.
Drum armature.
Disc armature.
Pole armature.
Armature revolved, magnet stationary.
Armature stationary, magnet revolved.
Armature and field stationary, keepers revolved.
Slow speed dynamo.
High speed dynamo.
Armature inside or outside of field magnet.
Poles of one sign only on each side of armature.
Poles of alternate opposite sign on each side.

This is rather a formidable list of features, and the adoption of any one of them in constructing a dynamo is a matter requiring close consideration and open to discussion, and probably only by long practice will a form of machine embodying the best of these features be arrived at.

High class mechanical workmanship and careful insulation with perfectly laminated iron cores employed in constructing any of the later designs of dynamos, produce a very good machine.

Large slow speed machines *versus* small high speed machines is a question which has been decisively settled in America in favour of the latter. The advantages claimed for slow speed machines do not exist in practice; they are apparently fanciful altogether, the first cost being considerably greater than for the high speed machines without any compensating advantages.

In all central stations space is valuable, and on that score the high speed machine has also the advantage; and then large dynamos are not so well suited for the work as small ones. Five 2,000 light dynamos are far better than one 10,000 lighter, as has been shown very clearly by the paper of Mr. Church recently published.*

Finally, in favour of high speeds, an engineer would rather run an armature weighing 200 lbs. at 1,000 revolutions per minute than run a magnet weighing one ton at a speed of 250 per minute, being able to use lighter belting, bearings, gearing—if any—less strain in driving, smaller foundations, and ease in handling the parts.

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* See REVIEW for April 13th, 1888.

By tabulating the features of some few dynamos of well-known makers and thereby ascertaining the differences in construction, it will be seen that they are all very much the same in action, and that one has been formed by turning another one *outside in* in most cases.

Compare, for instance, the Ferranti with the Muirhead-Hopkinson, also the Zipernowski, the Westinghouse and the Elwell-Parker machine described some time ago in the scientific journals. The majority are in favour of iron cores in the armature, and the tendency among those who have had most practice is towards high speeds and revolving armatures.

(*To be continued.*)

THE INSULATION OF MAINS FOR HIGH TENSIONS.

By G. L. ADDENBROOKE.

II.

IN the first article on this subject the power of the current to jump across air spaces was described, and some considerations were brought forward on the relative disruptive effects of equivalent continuous and alternating currents. Increasing practical experience, which points in the same direction as these considerations, makes it difficult to avoid the conclusion that alternating currents have not much, if any, more disruptive force than equivalent continuous ones.

Messrs. Warren de la Rue and Müller's experiments deal with this disruptive tendency of the current across air spaces. When dielectrics are placed between the two points of differing potential, although their *insulating* qualities are not so great as air, and may be very inferior, yet their power of resisting the disruptive effect of the current and preventing it passing through and piercing them is relatively very much greater. Exact experiments on this point are, as far as I am aware, wanting; but, as some guide, it may be mentioned that Mr. Spottiswoode broke a glass slab 3 inches thick by means of his induction coil when it was giving a spark 28 inches long in air. Again, I learn that with Mr. Wimshurst's large influence machine the Leyden jars, which are $\frac{1}{8}$th of an inch thick, are apt to get fractured after the spark has attained a length of 13$\frac{1}{2}$ inches. It may be noted that in the first of these cases the discharge is between points, in the second between two concentric cylinders. But a homely illustration, and one, perhaps, even more to the point, is to take a small induction coil giving $\frac{1}{8}$-inch or $\frac{1}{4}$-inch spark and set it going with a fairly constant battery. Connect two wires to the secondary, to one attach a smooth metal point, and to the other a plain metal surface, observe the distance at which the spark passes freely in air, now cover the metal point with some thin rubber sheeting stretched tight. When the rubber covering is so thin as to be almost invisible no spark will pass, even if the point is brought down on the metal surface.

As soon as any abrasion does occur in the rubber, either through a spark passing or by the point being rubbed on the metal surface, the sparks immediately become visible and the rubber usually retracts from the point. The potential difference in a coil giving $\frac{1}{8}$-inch spark can hardly be less than 5,000 volts. A given thickness of a solid dielectric such as rubber has then a much greater power of resisting the disruptive effect of the current than an air space of corresponding breadth; and, moreover, we see from this experiment that a very thin covering of India-rubber is sufficient to confine the current to its conductor, provided the covering is perfectly continuous.

From the above facts it would appear that the risk of perfectly sound insulation being burst up by even very high tension currents is small, and that, therefore, when faults do occur in insulated cables, they probably are owing in the first place to some discontinuity in the insulation.

This naturally leads us to consider the behaviour and action of currents as regards surfaces.

The amount of leakage which takes place across surfaces when experimenting with statical electricity at high potentials is well known; and also those who are concerned in electrical testing know well the amount of leakage which takes place across insulating surfaces at even low potentials. To obtain correctly the insulation resistance of a cable, it is always usual to clean and trim the dielectric at both ends for at least 3 inches, and sometimes in addition the ends are dipped in melted paraffin. If such precautions are not taken the leakage across the ends will often be sufficient to vitiate seriously the accuracy of tests in cables a mile long, and will consequently make an even greater difference on shorter lengths.

In this connection the small induction coil will again furnish some interesting experiments.

Set the coil going with a fairly constant battery, and note the distance the spark will pass in air. Now bring the two wires from the secondary down on any insulating surface. It will almost always be found that sparks will pass freely at a greater distance across the surface than they will through air. How much the increased distance will be depends largely on the state of the surface. For instance, if the surface be clean dry glass, or a freshly-cut surface of ebonite, or India-rubber, the distance will hardly be greater. But if it be an old surface which has been exposed to the air for some time, then the distance across which sparks will pass will be increased considerably, until it becomes twice or three times what it would be across an air space alone. If such surfaces be breathed on, or if, better still, they are wiped over with a little weak sulphuric acid and water, further curious effects will be observed. In the latter case the discharge will pass in a strange sparkling manner, accompanied by sinuous flashes across very considerable distances. This effect may also be observed in places on old ebonite surfaces which have not been treated as I have suggested, but which have apparently arrived at something like the same condition through the atmosphere acting upon them. Again, observe the distance a spark will pass across a sheet of paper; now very slightly damp the paper, and note the increased distance it will go and the larger area over which it seems to spread.

The presence of metal filings, dust, or mud will also enable the current to pass across greater distances than it would otherwise do.

We thus see that the tendency to disruptive discharge is favoured by surfaces, and will take place across a greater breadth of surfaces than solid dielectric or air space; and, further, that leakage is always taking place over exposed surfaces, moisture condensed on them favouring the passage of the current.

The passage of currents across surfaces also gives rise to an effect which requires notice. When a frictional machine or induction coil is worked, especially if the discharge is a silent one, ozone is generated, which is easily perceived by its peculiar odour. Enclosed switches, cut-out boxes, &c., through which high tension currents pass, always have this smell about them, and moreover, at times, a small discharge can actually be seen about such apparatus in the dark. Ozone is then generated by high tension currents (1,000—3,000 volts), and it is highly probably that it also is by currents of lower potential as they pass across surfaces. Ozone is most destructive to India-rubber, destroying rubber tubes through which it is passed in any quantity in a few minutes. It is a strong oxidising agent, and changes the rubber into a friable gum soluble in alcohol, which rubber is not. Ozone is not soluble in water, but in the presence of water is changed to hydrogen peroxide, the effects of which are just as deleterious.

It appears to me probable that when any crack or fissure occurs in insulation the current flowing across this generates ozone which disintegrates the rubber and so enlarges continually the area of the fault, which then offers increasing facilities for moisture to get in. Again, if the dielectric be vulcanised the sulphur in it will tend to form sulphuric acid in the presence of ozone, and this action would still further reduce the resistance of a fault.

Let us suppose that we have a conductor surrounded by moderately thick insulation, and that a high tension current is passed through it. If the dielectric is continuous and free from mechanical defects it will stand the tension. But let there be a crack or defect in the insulation somewhere, some current will flow across, and its passage will tend to increase the defect. The rate at which it will do so, and the consequences which may follow the presence of such a defect, depend on circumstances which from a practical point of view it is important to consider. The sectional surface of the insulation and the outside coverings of tape or braid will still offer a very considerable resistance, and if the cable is laid in a dry place will probably be sufficient to prevent the fault becoming anything more than a slight leak, even if there is metal close to the outside of the cable or in contact with it. But suppose the cable is in a damp or wet place, and that the outer coverings are in contact with damp earth, water or metal, and that the damp can penetrate through the outer coverings of the cable, the resistance of the outer coverings will be lowered very much, to a comparatively small number of ohms, so that at any rate from the outer surface of the dielectric to earth a passage is provided by which a considerable current would flow at the tension we are presuming would be in the conductor. Under such circumstances the whole strain due to the tension of the current is borne by the sectional surface of the dielectric at the fault. Moreover the moisture or wet will find its way into the fault either by soaking in or capillary attraction, which will again lower its resistance.

This is, with a few exceptions, the state of things which precedes a breakdown. The first effect of the current is no doubt to generate heat, dry up the moisture, and so tend to seal up the fault; but the disintegrating action on the rubber goes on, and the moisture finds its way in increasing quantity nearer and nearer to the conductor until sparks pass, or great heat is generated by the passage of the current. Carbonisation of the dielectric then begins to take place, which soon leads to the formation of a regular arc. It may be that this description of the final stages which lead to a breakdown is not quite complete or absolutely accurate, since what occurs must in some measure remain a matter of surmise, but it is not far from the truth, and in any case the main fact to recognise is that the almost invariable forerunner and accompaniment of a fault which leads to a breakdown is the presence of considerable quantities of moisture or water.

These, then, appear to be the principal physical facts with which we have to deal in attempting to use insulated conductors for carrying high tension currents. Before proceeding further it may be worth while to briefly enumerate them.

1. Disruptive discharges in the form of a spark will pass across air spaces, varying under the best conditions from $\frac{1}{200}$th inch at 1,000 volts potential to $\frac{1}{10}$th inch at 4,000 volts potential.

2. It is doubtful if the disruptive action of an alternating current is much, if at all, greater than that of an equivalent continuous one.

3. Dielectrics, such as rubber, offer much greater resistance to the disruptive action of the current than a similar breadth of air space does.

4. Disruptive discharges in the form of a spark will pass across greater intervals along surfaces than they will through air space alone, especially if the surfaces have been exposed to the air for some time, or are moist.

5. The action of the current passing across surfaces tends to accelerate chemical actions which lower the resistance of the material when the current passes.

Finally, there are these important and more immediately practical conclusions:

That a comparatively thin covering of dielectric is sufficient to confine a high tension current to its conductor, provided the dielectric is perfectly continuous and free from defects.

That when faults do occur they are due to some defect or crack in the insulation, and not to the current passing through it in a sound place.

Lastly, that for a fault in an insulated conductor to lead to the formation of an arc, and a subsequent breakdown under such conditions as are met with in practice, the presence of a considerable quantity of moisture is almost invariably necessary.

The whole question in its practical aspects is very similar to the one the civil engineer has to deal with in distributing water through pipes. The conditions which govern the flow of electricity along conductors are as well known as those which govern the flow of water through pipes. When the civil engineer has settled the size of his pipes, and the pressure they will have to work at, he has tables at his command which give him the strain cast iron will bear per square inch of different makes, according to the thickness, the allowance it is necessary to make for defects, and the margin of safety which is found sufficient. He knows, also, the corrosive action which different soils have on iron, and the extra precautions which must be taken to obviate its effects. Thus he is in a position to settle exactly how pipes are to be made to meet the exact circumstances with which he has to deal. Further, when the pipes have been cast to his instructions they are all tested to three or four times the pressure they will have to bear in use before being finally passed.

In trying to set forth thus briefly the behaviour of the electric current, and of dielectrics under electric tension, my object has been to introduce something of the same method into the construction of insulated conductors for conveying high tension currents as that which now governs the construction of water pipes to which it bears in method a good deal of similarity.

A NEW SYSTEM OF ALTERNATE CURRENT MOTORS AND TRANSFORMERS.*

By NIKOLA TESLA.

IN the presence of the existing diversity of opinion regarding the relative merits of the alternating and continuous current systems, great importance is attached to the question whether alternate currents can be successfully utilised in the operation of motors. The transformers, with their numerous advantages, have afforded us a relatively perfect system of distribution, and although, as in all branches of the art, many improvements are desirable, comparatively little remains to be done in this direction. The transmission of power, on the contrary, has been almost entirely confined to the use of continuous currents, and notwithstanding that many efforts have been made to utilise alternate currents for this purpose, they have, up to the present, at least as far as known, failed to give the result desired. Of the various motors adapted to be used on alternate current circuits the following have been mentioned:—1. A series motor with subdivided field. 2. An alternate current generator having its field excited by continuous currents. 3. Elihu Thomson's motor. 4. A combined alternate and continuous current motor. Two more motors of this kind have suggested themselves to me. 1. A motor with one of its circuits in series with a transformer and the other in the secondary of the transformer. 2. A motor having its armature circuit connected to the generator and the field coils closed upon themselves. These, however, I mention only incidentally.

The subject which I now have the pleasure of bringing to your notice is a novel system of electric distribution and transmission of power by means of alternate currents, affording peculiar advantages, particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power, and will show that many results heretofore unattainable can be reached by their use; results which are very much desired in the practical operation of such systems, and which cannot be accomplished by means of continuous currents.

Before going into a detailed description of this system, I think it necessary to make a few remarks with reference to certain conditions existing in continuous current generators and motors, which, although generally known, are frequently disregarded.

In our dynamo machine, it is well known, we generate alternate currents, which we direct by means of a commutator, a complicated device, and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilised in the motor, but they must—again by means of a similar unreliable device—be reconverted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor.

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* Read before the American Institute of Electrical Engineers, May 16th, 1888.

In view simply of this fact, alternate currents would commend themselves as a more direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by such currents.

But the operation of the commutator on a motor is two-fold; firstly, it reverses the currents through the motor, and secondly, it effects, automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the system, that is to say the directing of the alternate currents on the generator and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presented itself, How to perform this operation by the direct action of alternate currents? I will now proceed to show how this result was accomplished.

In the first experiment a drum armature was provided with two coils at right angles to each other, and the ends of these coils were connected to two pairs of insulated contact rings as usual. A ring was then made of thin insulated plates of sheet iron and wound with four coils, each two opposite coils being connected together so as to produce free poles on diametrically opposite sides of the ring. The remaining free ends of the coils were then connected to the contact rings of the generator armature so as to form two independent circuits, as indicated in fig. 9. It may now be seen what results were secured in this combination, and with this view I would refer to the diagrams, figs. 1 to 8*a*. The field of the generator being independently excited, the rotation of the armature sets up currents in the coils, *c*, *c*, varying in strength and direction in the well-known manner. In the position shown in fig. 1 the current in coil, *c*, is nil, while coil, c^1, is traversed by its maximum current, and the connections may be such that the ring is magnetised by the coils, *c*, *c*, as indicated by the letters, N, S, in fig. 1*a*, the magnetising effect of the coils, *c*, *c*, being nil, since these coils are included in the circuit of coil, *c*.

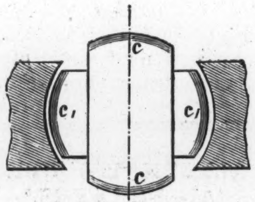

FIG. 1.

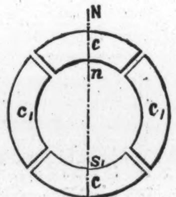

FIG. 1A.

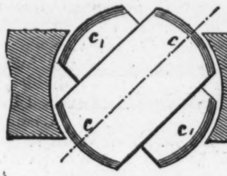

FIG. 2.

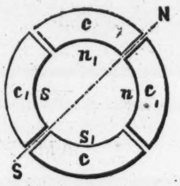

FIG. 2A.

In fig. 2 the armature coils are shown in a more advanced position, one-eighth of one revolution being completed. Fig. 2*a* illustrates the corresponding magnetic condition of the ring. At this moment the coil, *c*, generates a current of the same direction as previously, but weaker, producing the poles, n_1, s_1, upon the ring; the coil, *c*, also generates a current of the same direction, and the connections may be such that the coils, *c*, *c*, produce the poles, *n*, *s*, as shown in fig. 2*a*. The resulting polarity is indicated by the letters, N, S, and it will be observed that the poles of the ring have been shifted one-eighth of the periphery of the same.

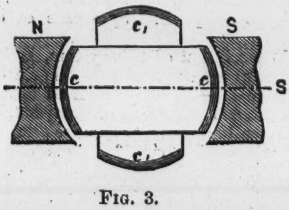

FIG. 3.

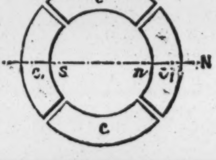

FIG. 3A.

In fig. 3 the armature has completed one-quarter of one revolution. In this phase the current in coil, *c*, is a maximum, and of such direction as to produce the poles, N, S, in fig. 3*a*, whereas the current in coil, c_1, is nil, this coil being at its neutral position. The poles, N, S, in fig. 3*a* are thus shifted one-quarter of the circumference of the ring.

Fig. 4 shows the coils, *c*, *c*, in a still more advanced position, the armature having completed three-eighths of one revolution. At that moment the coil, *c*, still generates a current of the same direction as before, but of less strength, producing the comparatively weaker poles, *n*, *s*, in fig. 4*a*. The current in the coil, *c*, is of the same strength, but of opposite direction. Its effect is, therefore, to produce upon the ring the poles, n_1 and s_1, as indicated, and a polarity, N, S, results, the poles now being shifted three-eighths of the periphery of the ring.

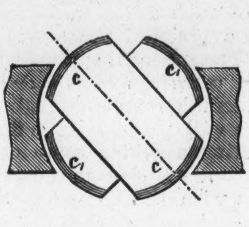

FIG 4.

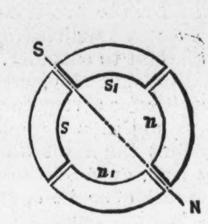

FIG. 4A.

In fig. 5 one-half of one revolution of the armature is completed, and the resulting magnetic condition of the ring is indicated in fig. 5*a*. Now, the current in coil, *c*, is nil, while the coil, *c*, yields its maximum current, which is of the same direction as previously; the magnetising effect is therefore due to the coils, *c*, *c*, alone, and, referring to fig. 5*a*, it will be observed that the poles, N, S, are shifted one-half of the circumference of the ring. During the next half revolution the operations are repeated, as represented in the figs. 6 to 8*a*.

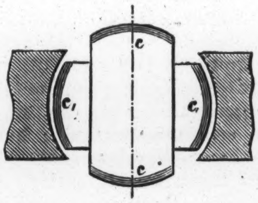

FIG. 5.

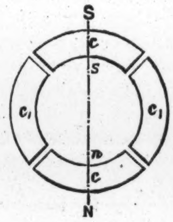

FIG. 5A.

A reference to the diagrams will make it clear that during one revolution of the armature the poles of the ring are shifted once around its periphery, and each revolution producing like effects, a rapid whirling of the poles in harmony with the rotation of the armature is the result. If the connection of either one of the circuits in the ring are reversed, the shifting of the poles is made to progress in the opposite direction, but the operation is identically the same. Instead of using four wires, with like result, three wires may be used, one forming a common return for both circuits.

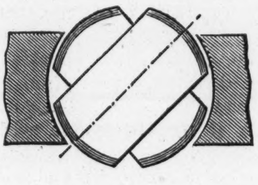

FIG. 6.

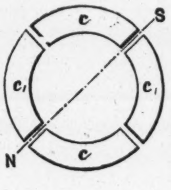

FIG. 6A.

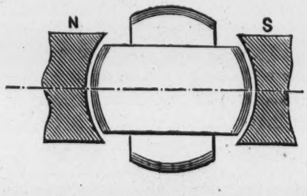

FIG. 7.

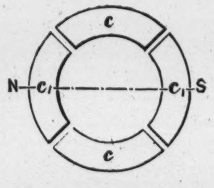

FIG. 7A.

This rotation or whirling of the poles manifests itself in a series of curious phenomena. If a delicately pivotted disc of steel or other magnetic metal is approached to the ring it is set in rapid rotation, the direction of rotation varying with the position of the disc. For instance, noting the direction outside of the ring it will be found that inside the ring it turns in an opposite direction, while it is unaffected if placed in a position symmetrical to the ring. This is easily explained. Each time that a pole approaches it induces an opposite pole in the nearest point on the disc and an attraction is produced upon that point; owing to this, as the pole is shifted further away from the disc a tangential pull is exerted upon the same, and the action being constantly repeated, a more or less rapid rotation of the disc is the result. As the pull is exerted mainly upon that part which is nearest to the ring, the rotation outside and inside, or right and left, respectively, is in opposite directions. When placed symmetrically to the ring, the pull on opposite sides of the disc being equal, no rotation results. The action is based on the magnetic inertia of the iron; for this reason a disc of hard steel is much more affected than a disc of soft iron, the latter being capable of very rapid variations of magnetism. Such a disc has proved to be a very useful instrument in all these investigations, as it has enabled me to detect any irregularity in the action. A curious effect is also produced upon iron filings. By placing some upon a paper and holding them externally quite close to the ring they are set in a vibrating motion, remaining in the same place, although the paper may be moved back and forth; but in lifting the paper to a certain height which seems to be dependent on the intensity of the poles and the speed of rotation, they are thrown away in a direction always opposite to the supposed movement of the poles. If a paper with filings is put flat upon the ring and the current turned on suddenly, the existence of a magnetic whirl may be easily observed.

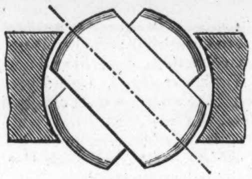

FIG. 8.

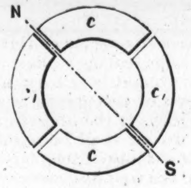

FIG. 8A.

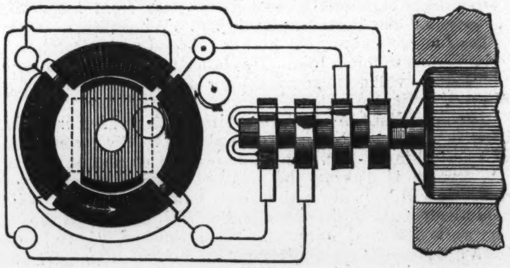

FIG. 9.

To demonstrate the complete analogy between the ring and a revolving magnet, a strongly energised electro-magnet was rotated by mechanical power and phenomena identical in every particular with those mentioned above were observed.

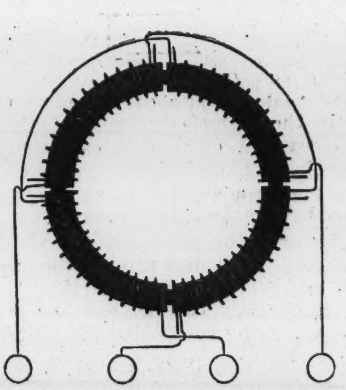

FIG. 10.

Obviously the rotation of the poles produces corresponding inductive effects, and may be utilised to generate currents in a closed conductor placed within the influence of the poles. For this purpose it is convenient to wind a ring with two sets of superimposed coils, forming respectively the primary and secondary circuits. In order to secure the most economical results, the magnetic circuit should be completely closed, as shown in fig. 10, and with this object in view the construction may be modified at will.

The inductive effect exerted upon the secondary coils will be mainly due to the shifting or movement of the magnetic action; but there may also be currents set up in the circuits in consequence of the variations in the intensity of the poles. However, by properly designing the generating and determining the magnetising effect of the primary coils, the latter element may be made to disappear. The intensity of the poles being maintained constant, the action of the apparatus will be perfect, and the same result will be secured as though the shifting were effected by means of a commutator with an infinite number of bars. In such case the theoretical relation between the energising effect of each set of primary coils and their resultant magnetising effect may be expressed by the equation of a circle having its centre coinciding with that of an orthogonal system of axes, and in which the radius represents the resultant, and the co-ordinates both of its components. These are then respectively the sine and cosine of the angle, a, between the radius and one of the axis (o x). Referring to fig. 11 we have $r^2 = x^2 + y^2$; where $x = r \cos a$, and $y = r \sin a$.

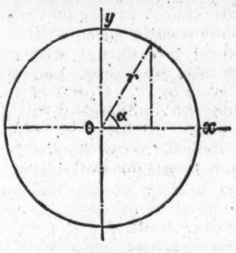

FIG. 11.

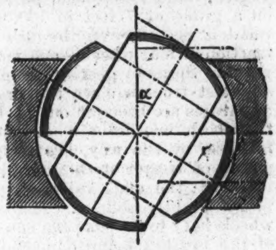

FIG. 12.

Assuming the magnetising effect of each set of coils in the transformer to be proportional to the current—which may be admitted for weak degrees of magnetisation—then $x = \text{K}\,c$ and $y = \text{K}\,c^1$, where K is a constant and c and c^1 the current in both sets of coils respectively. Supposing further, the field of the generator to be uniform, we have for constant speed $c^1 = \text{K}^1 \sin a$ and $c = \text{K}^1 \sin (90° + a) = \text{K}^1 \cos a$, where K^1 is a constant. See fig. 12.

Therefore

$$x = \text{K}\,c = \text{K}\,\text{K}^1 \cos a,$$

$$y = \text{K}\,c^1 = \text{K}\,\text{K}^1 \sin a, \text{ and}$$

$$\text{K}\,\text{K}^1 = r.$$

That is, for a uniform field the disposition of the two coils at right angles will secure the theoretical result, and the intensity of the shifting poles will be constant. But from $r^2 = x^2 + y^2$ it follows that for $y = 0$, $r = x$; it follows that the joint magnetising effect of both sets of coils should be equal to the effect of one set when at its maximum action. In transformers and in a certain class of motors the fluctuation of the poles is not of great importance, but in another class of these motors it is desirable to obtain the theoretical result.

(To be concluded.)

AMERICAN NOTES.

By DAS TELEPHON.

I SEND to-day a report on the electro-motor car, by Mr. Donaldson, the electrical engineer of the Electric Storage Company, of Baltimore, to whose indefatigable and unwearied exertions is attributable the great success of this mode of street car traction. During the past five years Mr. Donaldson has energetically worked at it until he has proved that it is entirely successful. In his labour he has had the advice of the professors of the famous Johns Hopkins University in Baltimore. I enclose a wood cut of the "Electric Storage car," of which I heretofor wrote you, upon which I have made several journeys, and I can assure you that the car ascended the steepest grades and went around sharp curves without using all the electric power, and was frequently stopped on hills and again resumed its onward ascent.

"Baltimore, Md., *May 25th*, 1888.

"Dear Sir,—On Monday, May 28th, 1888, the Electric Storage Company of this city will put a car, operated by electric storage batteries, on the streets to run on schedule time. We have been taking many trial trips over the different street railway companies' tracks, and now have settled upon the worst line in respect to gradients, curves and fast schedule time on which to demonstrate to the people of this hilly city what a great advance in every way electricity is as a mode of propelling street cars. The car in question was built especially for the work, and the outfit consists of 124 cells of the 125 ampère hour type, weighing 4,500 pounds, and of two (2) 7½ horse-power Sprague motors, weighing 1,600 pounds, which, with the car at 7,000 pounds, makes a total weight of 13,100, or a little over $6\frac{1}{2}$ tons. The car is 22 feet long and will seat 24 passengers, with a total carrying capacity of 75. Our average run per charge of battery is between 35 and 45 miles. This distance is with an average load, and going at the same rate as the horse cars, which is about 5 miles per hour. The circuit is controlled by a circular switch (one on either platform). The direction of the car is changed by a single movement of the switch which reverses the direction of the current through the armatures. The battery is divided in four parallels of 31 cells each, giving an E.M.F. of 62 volts, two parallels of 62 cells each, giving 124 volts, and all in series giving 248 volts. The armatures of the two machines, which, by the way, are series wound, are always in parallel, and in series with the sides. The switch has six movements as follows:—

1st	battery	four	parallels,	62	volts,	fields	in	series.
2nd	„	„	„	„	„	„	„	parallel.
3rd	„	two	„	124	„	„	„	series.
4th	„	„	„	„	„	„	„	parallel.
5th	„	in	series	248	„	„	„	series.
6th	„	„	„	„	„	„	„	parallel.

The resistance of each armature is about one ohm; that of each field one-half ohm. With this arrangement of batteries and motors a great rush of current at the starting of the motor is prevented, and the torque or pull is very great, enabling us to start on a grade of 7 feet in 100, with a total load of ten (10) tons. Sand is necessary on the rails in gummy weather, even with the traction of four wheels—one motor geared to each axle with the regular Sprague gearing, from which we have never had the slightest trouble since the first day we ran. The coils of the armatures are brought out at both ends to commutator bars, so that both brushes are on top and easily attended to. The brushes, by the way, are something unique, being simply five pieces of copper $\frac{1}{16}$th inch thick and $1\frac{1}{4}$ inch broad, rivetted together; the ends knifed-shaped, and bearing on the commutators slightly oblique. The ratio of speed of armature to car wheels is 12 to 1. One can run backward or forward with no fear of the brushes being damaged. From readings taken with a Thomson voltmeter and ammeter, we find that current is used about half the time we are running, and the average current is 10 amperes, with 7 tons. The readings were taken every 200 feet or half block, and at all curves. On a seven (7) per cent. grade the current, when going faster than horse cars, at an E.M.F. of 248 volts, was 60 ampères, with a total weight of 7 tons. The maximum current of a grade of 2 per cent. and curve of 29 feet 9 inches radius was 46 ampères. On a level we are able to attain a speed of 10 miles per hour with 7 tons, using 30 ampères at 248 volts.

"We hope in the near future to take a branch of a street car line, which has at present 10 cars, and equip it with storage batteries and motors. The cells on our present car consist of 17 lead-antimony Faure-Sellon plates, with a positive surface 3·4 square feet.—Yours very truly,

"WM. W. DONALDSON,

"*Electrician, Electric Storage Co., Baltimore, Md.*"

The attention of inventors and patent attorneys is called to the decision of Judge Wallace, U.S. Circuit Court of New York, in the case of the Edison Electric Light Company *versus* United States Electric Lighting Company. The judge said:—"The question presented depends upon the meaning and effect of section 4,887, United States Revised Statutes, which is as follows:—

"'No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years.'

"The real enquiry is, whether the section limits the term of a domestic patent to the term of a foreign patent when the application for the foreign patent is not made until subsequent to the application in this country, but the foreign patent issues before the domestic patent. The precise point now raised by the complainant, but made with reference to the effect of section 25 of the Act of 1870, was considered by this Court in the Gramme Electrical Company *v.* the Arnoux and Hochhausen Electric Company, 21 Blatch., 450. It was insisted by the defendant in that case that the complainant's patent expired at the date of the expiration of an Austrian patent, and the complainant took the position that the defence was not tenable because the application for his United States patent was filed before the application for the Austrian patent was made. It was held by Blatchford, J., that the date of the application for the United States patent could not affect the question, and that the meaning of the statute was that the United States patent should expire at the time of expiration of the foreign patent irrespective of the time when the foreign patent was applied for. Judge Blatchford adopted in that case the views of Judge Nixon upon the same question in Bate Refrigerating Company *v.* Gillett, 13 Fed. Rep., 553. In the Bate case the question arose under section 4,887, and it was contended that complainant's United States patent did not expire at the date of the expiration of a Canadian patent, because the application for his patent was filed antecedent to the application for the grant of the Canadian patent. The Court was of the opinion that it would be wresting the language of the section from its plain and obvious meaning to sustain that position. These decisions have been followed by Bradley, J., upon a subsequent hearing in the Bate case, and by Colt, J., in Bate Company *v.* Hammond (First Circuit U.S.). In view of these decisions the question cannot be considered as an original one. The Bill alleges the infringement by the defendant of letters patent of the United States, No. 263,140, dated August 22nd, 1882, granted to the complainant upon the application of Edison for an improvement in dynamo-electric machines, the invention of Edison. The Bill shows that Edison made his application for a patent August 9th, 1880, and assigned his title to the complainant June, 1881. The plea in defence alleges that prior to the granting of the complainant's letters patent the invention or discovery, described and claimed therein, had been patented by Edison, or with his knowledge, consent, and procurement, by a public patent of the Austro-Hungarian Empire, granted to Edison July 21st, 1881; but the term thereof expired July 21st, 1883, and before the commencement of this suit. The plea is, therefore, allowed."

Inventors and patent attorneys should, in order to secure the full term of a United States patent, arrange to have the U.S. patent issued before the issue of the foreign patent, irrespective of the dates of the filing of the applications in either country.

I have frequently endeavoured to enlighten your intelligent and knowledge seeking readers upon the wonders, natural and artificial, which abound in this boundless Yankee country. I send you short accounts of two natural wonders. The one is a well charged with electricity. According to reports, the water in a well which has been driven near Lebanon, Mo., is heavily charged with electricity. All the machinery and tubing connected with the sinking of the well has become magnetised, and any piece of steel will become magnetised when rubbed on the pipes. If a circuit is formed by touching two pieces of pipe a shock is felt. The water also has the property of magnetising any steel substance which is placed in it while hot. The water retains its magnetic power when taken from the well. People are taking the water away by the barrel.

The other is a walking electric battery. The wonder is Henry Luegeman. Three years ago, during a storm, he was engaged in gathering tanbark, when the tree from which he was taking it was struck by lightning. Luegeman received a severe shock. It transformed him into a genuine electric man. Anyone who shakes hands with Luegeman now receives a severe shock. By passing the blade of a knife between his thumb and finger during the progress of a storm, he charges the metal so strongly that heavy weights can be lifted. When flies alight upon him they drop dead, and when he is is in a dark room sparks flash from his flesh, and his eyes shine like incandescent lights. Whenever a storm approaches Luegeman becomes highly charged with electricity, and it is dangerous to touch him. He claims to feel no inconvenience, except that he will go near no moving locomotive for fear of being drawn against it and killed.

The genuine Yankee seems to be tired with making *great* things, and has now turned his mechanical powers to the construction of great *small* things—of which a microscopic engine is the latest. W. A. Lyman is making the smallest possible specimen of an engine. It will be made with a silver half dollar. The boiler is to hold about eight drops of water, but with four drops the engine can be worked several minutes. When finished it is to be placed under a glass case three-quarters of an inch in diameter, and an inch and one-eighth in height. Some of the parts will be so fine and delicate that they cannot be made without the use of a magnifying glass.

A CONSTANT BATTERY IN WHICH THE NEGATIVE ELECTRODE IS CARBON.

By MM. FARINGI and FARKAS.

ON resuming the experiments of Jablochkoff, the authors find that in spite of the high temperatures employed in the batteries proposed by him the possibility of a constant current is essentially excluded. Their experiments have led them to the construction of a battery giving a current more constant than that of any other battery previously known.

In this element the positive electrode is platinum. Two electrolytic conductors are in action: caustic soda or potassa, and the compound obtained by heating platinum along with caustic soda or potassa. On analysis the following composition is found:

$$Na_2\,O,\ 2\,Pt\,O_2 + 6\,H_2\,O$$

or possibly

$$2\,Pt\,(O\,H)_3\,(O\,Na) + 3\,H_2\,O.$$

This compound covers the inner surface of a small platinum pan and forms an adhesive coating. The pan is filled with caustic soda, previously melted in a silver crucible. A small gas flame serves as a source of heat.

Retort coke is then immersed in the fluid, and the element is covered with a screen.

The battery being closed, the electromotive force reaches a certain value and becomes stationary. The carbonate of soda produced either at the negative electrode or on the surface of the melted salt is eliminated continuously, and appears in the state of crystals on the free sides of the two electrodes. The authors find that the electromotive force varies directly as the temperature near the carbon, but inversely as the temperature near the platinum. Other things being equal, the intensity of this latter variation is less than that of the former. If we call T the temperature of the carbon, T′ that of the platinum, and U the electromotive force, we have

$$\frac{\partial U}{\partial T} > 0, \quad \frac{\partial U}{\partial T'} < 0,$$

but always

$$\frac{\partial U}{\partial T} + \frac{\partial U}{\partial T'} \; T' = T > 0.$$

Then in the case of the equality of the two temperatures, T and T′, the electromotive force varies in the same manner as the common temperature, T′ = T. In this case we have

$$d\,U = \left[\frac{\partial U}{\partial T} + \left(\frac{\partial U}{\partial T'}\right) T' = T\right] d\,T.$$

If the gas flame merely undergoes inevitable variations, so long as the loss of the quantity of the salt melted does not exceed a certain limit, the variations of the electromotive force are not perceptible. This loss bringing about a decrease of the immersed parts of the electrodes occasions a slow variation in the difference of the temperatures, T and T′. But with suitable arrangements this influence is manifest only in the course of some hours.

For an abrupt and considerable variation of the external resistance, the difference of potential at the poles experiences merely a transient and very brief variation.

If an electrode of silver is substituted for that of platinum, the silver is deposited upon the carbon in brilliant crystals, and a constantly increasing polarisation sets in. This phenomenon occurs also if the poles of the battery are isolated.

THE ROYAL BOTANICAL GARDENS, MANCHESTER.

THESE gardens, situated at Old Trafford, which formed the site of the Royal Jubilee Exhibition of last year, have recently been reopened to the public under considerably altered circumstances, due in a great measure to the success attending last year's exhibition. The principal portions of the expired exhibition have been removed, but such portion as remained within the gardens have been utilised; thus the entrance has been transformed into a dining room, the long main approach into a conservatory and promenade, and the portion next the dome into a concert room.

The various buildings in the grounds, the pagodas, and Old Manchester and Salford have been removed, the grand promenade with the band stands remain, whilst the gardens themselves have been made picturesque and inviting.

The council of the Botanical Gardens determined to render the gardens more than usually attractive this year by giving, in addition to the ordinary botanical *fêtes*, a weekly series of concerts, both indoors and in the gardens; and as the music was much enhanced last year by the extensive adoption of the electric light, it was determined this year to carry out the same idea on somewhat similar lines, but with every prospect of an improvement in effect.

Accordingly it was settled that the gardens should be lighted throughout with the arc light, and arrangements were finally concluded with the Manchester Edison-Swan Company, of 14, St. Anne's Square, Manchester, to supply and fix 56 arc lamps of 2,000 candle-power (nominal) each, and to provide the necessary electrical plant for working the same. The same company, it may be remembered, carried out last year the whole of the extensive system of incandescent lighting throughout the Jubilee Exhibition.

The arc lamps selected for the present lighting are of a new type, invented by Messrs. Phillips, Harrison and Hart, of a remarkably compact form and very neat in design; the working parts are very simple, and there is little liability of their getting out of order.

These lamps are worked with a current of 10 ampères and 50 volts, and the light given is brilliant and remarkably steady, without possessing those rose and violet coloured tints so frequently seen and which are so objectionable. The arc lamps in the dining rooms were found of so steady a character, that after a short time their presence as lighting the room passed unnoticed. In the promenade and concert room and also throughout the grounds, the same number of lamps are fixed as were in use last year, and as comparisons could not possibly be avoided. These turned out very much in favour of the present system, for the light from the new arc lamps was unquestionably of a higher efficiency than that from those employed during last year's exhibition. In the grounds this effect was also the more strongly marked as instead of the lamps being fixed on high masts and in clusters, they were attached to shorter posts and were more effectual in lighting the promenade. It was found that a better distribution took place and the general effect was much superior. The conducting wires—the lamps being arranged on more than one circuit—consisted of bare copper wire carried from pole to pole, and at night were imperceptible, but in the daytime the effect was not pleasing, although showing the practical manner of carrying out the work.

Not far from the concert room a small building contains the machinery for supplying the power, which consists of an engine and two large dynamos. The engine is a fine example of the work sent out by the well-known firm of Marshall, Sons & Co., of Gainsborough, it is a 35 H.P. nominal high pressure stationary engine fitted with automatic expansion valve gear and arranged underneath a locomotive multitubular boiler. The engine runs at a speed of 120 revolutions per minute with a steam pressure of 90 lbs. in the square inch in the boiler. The engine was fixed by Messrs. F. B. Welch & Co., of Manchester, sole agents in the district for Messrs. Marshall.

The two dynamos, which are driven by Rossendale belting, were specially designed and built for this work by Elwell-Parker, Limited, of Wolverhampton. They are shunt wound, and each capable of working 40 arc lamps of the Phillips and Harrison type, with a total E.M.F. of 2,000 volts. They are slow speed machines, running at 700 revolutions per minute, and working very smoothly, without any sparking at the brushes. In the dynamo room there is a good arrangement of current indicators, and also switches controlling the different circuits.

This installation has been running with marked success, and has obtained the public approval; when inspected by ourselves everything was running in perfect order and very smoothly, whilst the lamps were remarkably steady, and gave an exceedingly well diffused light of more than the usual effective candle-power. The work has been organised and carried out entirely under the personal superintendence of Mr. J. R. Williamson, A.M.I.C.E., managing director of the Manchester Edison-Swan Company, to whom the success of the lighting is mainly due. The work so far carried out is of a permanent character, and the capacity of the entire plant is greatly in excess of the present requirements.

Electric Lighting in Vienna.—The electric light is to be introduced into the two Vienna suburbs of Neubau and Mariahilf, the two chief industrial districts of the capital.

REVIEW.

Management of Accumulators and Private Electric Light Installations. By Sir DAVID SALOMONS. London: Whittaker & Co.

It would seem scarcely credible for a man of Sir David Salomons's opportunities and accomplishments to send out this, the *fourth* edition of his book, so full of errors and anomalies. We remember feeling rather disappointed with the first edition of the "Handbook on the Management of Accumulators," which appeared about two years ago, but we had then every hope that succeeding volumes would be "revised and enlarged" advantageously. We believe that the author has now, with his latest attempt, done his worst, though he seems to be imbued with that strange infatuation which leads men who imagine themselves exceptionally blest to almost ignore the criticism of their friends. Sir David has been too leniently dealt with. He writes not for gain, but with the worthy object of imparting information; at least, this he professes in the preface to the third edition, where we read: "The author feels confident that if the directions here laid down are carefully followed, they will prove of great service, *and very rarely, indeed*, will professional advice be required." Yet in his summary to Chapter VI. the author states that "at all times possessors of an accumulator should not spare money *in sending for competent persons to set any fault aright*, for a trifling matter grows very serious in a short time, and by this course much good money is saved and vexation avoided." The italics are our own. Whether we are justified in crediting Sir David with infatuation can be judged by perusal of his preface to the present edition, where he tells us that "up to the present time there is no other book written on the management of an accumulator. This has created some surprise, although when the reasons are examined it becomes clear." We have never heard anybody express surprise at this, and we know that makers of accumulators *do* give instructions, verbal, written and printed, to their customers, concerning the treatment of their wares. "Two classes of persons are interested in batteries," says the author, "namely, the seller and the buyer. The former know (*sic*) comparatively little of their properties; for as the cells are made they leave the works, and their knowledge [whose knowledge?] is confined to laboratory tests, and it is not to their interest to publish all their shortcomings. The user, on the other hand, has rarely the knowledge to examine the question." It therefore remained for Sir David Salomons to attempt "to fill the gap which lies between the manufacturer of cells and the general user," and to trust that "it will prove of benefit to both." Since the author only recognises two firms, and since he professes to treat of the virtues and vices of just two types, and no other, we must imagine that this "gap" would be of a peculiar shape, were it possible to represent it graphically.

We cannot think that the Electrical Power Storage Company, or Messrs. Elwell-Parker, will feel flattered with the above proposition, for they are well able to take care of their own side of the "gap," and we dismiss the very idea that either of these firms or their officials stand in need of the education thus offered by Sir David. There remains therefore only the one side of the "gap" to be considered and the way in which it is proposed to fill this monstrosity of space.

Part I., Chapter I.—"Description of cells and their mode of employment." The author still adheres to this awful definition: "A cell is the receptacle for the liquid and plates, but generally the word is employed to signify the vessel with contents complete, unless the contrary be implied. A number of cells connected together form a battery, or, as it is now generally termed, an accumulator, *i.e.*, when the battery is a secondary one." Then, again, "cells are of two kinds—primary and secondary. The primary cells are made in as many ways as there are stars in the sky, but all have one characteristic—namely, that when exhausted the whole or part of the chemicals must be renewed and sometimes the plates also." "The other cells are termed secondary, because, without putting in fresh chemicals, they may be revived by simply passing a current through them." Why does Sir David refuse to follow the simple common sense definitions which he can find in every respectable elementary textbook? In the attempt to appeal to the *practical mind* the author blunders with his own obscure versions, and every page displays some fearfully and wonderfully constructed sentences. The Planté plates are described as having "luggs [observe the spelling and definition in Nuttall's] cast on them or put on afterwards to project above the level of the electrolyte," and "the chief drawback to this type of cell is that frequent reversals are necessary to obain good storage capacity, and when the maximum capacity is reached the plates become rotten." Are not the lead grids of the "pasted types" also liable to "become rotten?" With positive plates this is a question of time, and it depends upon their thicknesses as to how soon the metal is entirely converted into an oxide. Sir David describes some improvements which he suggested to Messrs. Elwell-Parker in 1887 and states that the newest kind of E.P.S. cell, called the 1888 type, follows closely upon his own. Time will show how far these modifications can be called "improvements," and with us it is a question of doubt whether the strong wooden frames, which hold the plates together, can serve the intended purpose for a sufficient length of time. Wood is an awkward material when in contact with sulphuric acid; no matter how well it be "boiled in paraffin," or coated with any kind of hydrocarbon, it assumes too soon those conducting qualities which cause a continuous leakage between plates of opposite sign in the box and reduce the efficiency very materially.

Referring to running accumulators in parallel, the author states that "two batteries in parallel also keep in better order than cells coupled two and two." We have always found the reverse to be the case, and we would like to know how Sir David manages to insure the same amount of charge in two series coupled through the first and last cells only, unless he attends most carefully to instruments inserted in each set, or unless he introduces some very complicated automatic resistance regulator. It is almost impossible to keep the strength of acid uniform in all the cells; adjust it as often as we may there is sure to be a considerable difference again after the next few charges and discharges. The very fact that the internal resistance of a secondary cell is so minute adds to the difficulty of balancing the sum of the resistances of two or more sets; moreover, there is always a slight difference in the metallic resistances of the connections outside the cells. By coupling cells "two and two" we can avoid the multiplication of those errors.

Chapter II. treats of "setting up the cells and the accumulator house." This gives a few useful hints to amateurs, who like to arrange such matters for themselves, or to buyers in the colonies until the manufacturer sets up a branch establishment having a properly schooled staff. It is curious how little there has been done with accumulators in distant parts of the world, notwithstanding the "improved types" which turn up periodically, say every January, and notwithstanding that this book explains them and their uses.

"Charging," in Chapter III., gives some useful information, and here there are fewer holes to pick. For the first charge, "which differs in some respects from charging in the general way, there should be a steady run of thirty hours without stoppage, if possible; or not less than ten hours a day during three days for the usual size cells." The author does not specify the dimensions of the "usual size," but mentions later on that "it is found best to use cells with 15, 23, or 31 plates each. Those containing 31 are not much employed on account of their weight." It would puzzle a novice to find out which of the above should be called "usual." That the cells with the smaller number of plates are almost universally used for stationary work by the E.P.S. and E.P. companies is not so much due to the lesser weight as to the fact that very large cells never gave the same satisfaction in working, and they are more difficult to construct. Glass, being mostly used for the receptacles, has proved too expensive and too troublesome to make in large dimensions. The plates, moreover, seem to be less happy the more neighbours they have in the same bath. As a matter of fact, there are not two plates in the same box which can be said to do precisely the same duty. Some have a greater propensity for "growing" than others, and in general each element tries to play tricks on its own account, and this is more noticeable in big cells. The largest cells we have seen contained 166 plates of the E.P.S. L type, and these came to grief very quickly, whilst the same kind of plates of the same period in groups of 15 behaved sociably and were law-abiding. Generally speaking, the troubles are in proportion to the number of plates in a cell. Sir David's experience is principally confined to the sizes used in his own house, and he has not been through "the mill" of the manufacturer, who not only had to find out *how to make* accumulators, but also *how to maintain* those he made, and in the early days the makers were held responsible for the working of their wares, and their greatest and hardest experience, as also the most valuable experience was obtained *outside the laboratory*, of which the author speaks rather ironically. The tables on pages 42 and 43 were made up by Mr. Fitzgerald to suit the "lithanode" controversy; we should have preferred another compilation from an independent party.

Page 44 brings the following startling statement:—"Water is a very bad conductor, and $H_2 S \cdot O_4$ a good one; therefore, the weaker the acid the worse the conducting qualities" (!). Every student of physics must know that concentrated sulphuric acid is a *bad conductor*, and even within the limits of dilute acid Sir David Salomons's assertion is wrong. According to Mathiessen, sulphuric acids of 1·018 s.g. and of 1·827 have practically the same conductivity, and it will be found that the conductivity rises only until the density reaches about 1·225; beyond this, it falls again almost as rapidly.

Chapter IV., on "Discharging," contains nothing but what may be found repeatedly in other parts of the book; but in Chapter V., on "Failures: their Causes and Remedies," the author offers a number of really useful hints to those who have to handle E.P.S. batteries and repair them. Chapter VI., if perused by a would-be purchaser, will deter him from becoming an actual one, unless he feels he has "brains" enough to leave the subject in the hands of those who understand it.

Part II. contains descriptions and recommendations of certain engines, dynamos, switches, and all sorts of apparatus, resembling more a general agent's price-list, and on these we offer no opinion.

Concerning Sir David's criticism on the fire-risk rules of the Society of Telegraph Engineers, his posing as a censor upon the conduct of electric lighting companies and his advocacy of the formation of an electrical association, these and other eccentricities were commented upon in our last issue. To sum up, we consider this volume badly compiled, carelessly written, and ill-arranged; and we hope to see great improvements in future editions. That there is a demand for a book on accumulators is evidenced by the fact that this one has reached the fourth edition.

The Schanschieff Battery.—The directorate of the Schanschieff Company has not yet explained to us the cause of the suspension of business, so we can only assume that such a course is thought neither necessary nor politic. We have, however, heard by a side wind that the promotion consideration has been regarded as being very much too high, and that this alone has influenced the directorate into returning the share money subscribed. If this turns out to be the correct version of the split in the Schanschieff camp, we shall flatter ourselves that our comments at the time the company was registered were not altogether beside the "Marks."

NOTES.

Sheffield and the Electric Light.—The lighting sub-committee of the Watch Committee of the Sheffield Town Council has had under consideration a letter from Mr. Tasker, regarding the adoption of the electric light in lieu of gas for lighting a number of streets in the centre of the town, but thinks it inexpedient to make any change at present.

Electrically Lighting a Ball Room Afloat.—"The glorious first of June" was celebrated on H.M.S. *Indus*, steam reserve ship at Keyham, by a ball, given by Capt. H. H. Rawson, C.B., and the officers of the ship. Great efforts were made to make the affair unusually attractive, and amongst other means adopted, the aid of the electric light was called in. Mr. W. Brockman, R.N., gunner and torpedo officer, superintended the fitting up of an installation consisting of 190 Edison-Swan incandescent lamps, two of which were of 50 C.P. and the remainder of 16 C.P. The lamps were arranged in five circuits, each circuit being fitted with an independent switch and cut-out, and so joined up to the switchboard that should either of the two machines employed break down the illumination of the ship would not be seriously interfered with. The dynamos, Siemens D 2 type, compound-wound, each giving 100 ampères at 80 volts, and working at 430 revolutions per minute, were situated on another vessel 200 yards distant. The lights were very steady and burned for eight hours, giving satisfaction and pleasure to the numerous company. Mr. Brockman is to be congratulated upon the results he obtained under rather trying circumstances. The wire at his disposal, we are informed, was old and almost worn out, but was made to answer the purpose after being insulated anew and carefully tested.

Portable Electric Light Plant.—The descriptions of the Railway Exhibition in Vienna mention a novel electric light plant upon a wagon, which is the property of the State. Its use is to be conveyed from place to place where troops are being entrained or detrained, facilitating the operations by lighting the stations with electricity.

Birmingham and the Electric Light.—No definite steps have yet been taken with respect to the proposal to supply the electric light to the block of buildings bounded by Corporation Street, New Street, High Street, and Union Street, but the Midland Electric Light and Power Company, Limited, is still pursuing inquiries as to the number of persons likely to accept the terms on which the company proposes to undertake the work. The chief difficulty in the way of obtaining the requisite number of assentors to the proposal is the reluctance of many of the shopkeepers to dispense with their expensive gas fittings. Most of them, however, would be willing to support the company if the latter would consent to inaugurate the installation and leave it to the shopkeepers themselves to decide when they should utilise the light. Arising out of the proposal has sprung another, the company having been asked to consider the feasibility of fitting up a small central station for the purpose of supplying with the electric light large new premises which are being erected.

Derby Exhibition Lighting.—One of the principal features of the industrial exhibition which has been held in Derby during the past fortnight, was the electric light exhibit of Messrs. John Davis and Son of that town. The dynamo, which was a 4-unit "Castle" machine, was driven by a 3 H.P. "Stockport" engine, and the lamps exhibited comprised a 2,000 C.P. and a 400 C.P. "Castle" arc lamp, and a 400 C.P. "Sunbeam" incandescent lamp, as well as half-a-dozen Edison-Swan 16 C.P. incandescent lamps. The local gas company, with commendable prudence, had offered reduced terms to the exhibition, on condition that no electric light should be allowed in the main hall, so that the lamps were confined to the entrance; but the arc lamp in the archway leading to the hall was quite near enough for purposes of comparison with the gas lamps.

Omnibus Lighting.—Says the *St. James's Gazette* of Saturday last: Within the last few days electric lighting has made a very practical advance. The cheapest line of omnibuses in London—probably, regard being had to its equipment, the cheapest in Europe—has just been furnished with this light; and doubtless before the winter sets in, the improvement will be extended to the whole system.

Electric Lighting at Derby.—The lead of Messrs. Bardill & Co., who have now for some considerable time lighted their shop in Peter Street by electricity, is about to be followed on a much larger scale by Messrs. John Davis and Son, who contemplate putting down in their premises at All Saints' works, a large electric plant for the purpose of distributing light and power to neighbouring shops.

St. James's and the Electric Lighting.—The St. James's and Pall Mall Electric Light Company was on Thursday last granted by the unanimous voice of the vestry a licence for the supply of the electric light in the parish of St. James.

Paddington and the Electric Light.—At the last meeting of the Paddington Vestry, in the report of the legal committee brought up by Mr. Hill on this subject, Dr. Danford Thomas suggested that an application should be made to the Board of Trade for a licence or order under the Electric Lighting Act, for supplying the whole borough of Paddington with the electric light, and with power to transfer or lease any portion of their rights and privileges. Dr. Danford Thomas recommended that the matter be referred to the Works Committee. Mr. Mark Judge seconded, and this was carried.

Exeter and the Electric Light.—Exeter Town Council held a special meeting on Wednesday last week, under the presidency of the Mayor (Mr. Roberts), and again discussed the subjects of the electric lighting of a certain area of the city. A committtee which had been appointed reported in favour of tenders being advertised for for the lighting of a portion of the city. Alderman Daw suggested that this could not be done until either an Act of Parliament, a licence, or a provisional order had been obtained. Mr. Townsend, in moving the adoption of the report, mentioned that the gas company in Exeter had already had a fifty years monopoly, and it would considerably benefit the people of Exeter if some sort of competition could be introtroduced. He (Mr. Townsend) had been twitted with holding a brief from an electric light company, but this he denied. Mr. Ball seconded the adoption of the report, and Mr. Wreford pointed out that the advertising for tenders committed the council to nothing. In the course of further discussion, which was mainly of an irrelevant and wordy character, an amendment was submitted by Mr. Bowden to the effect that the consideration of the report should be deferred until the specifications had been printed and circulated among the members of the council. This was, however, defeated, and the report was adopted, it being ultimately decided that tenders should be sent in by the 22nd September, and be presented to the meeting of the Urban Sanitary Authority on the 29th of the month. On the motion of Mr. Townsend, it was also decided to determine the council's contract with the gas company. Alderman Daw called attention to the fact that the electric light company had acquired certain property at Trews Weir, and intended cutting a water-way which, it was hinted, might detrimentally affect the canal. It was stated that the navigation committee had prepared a report on the subject, in which they recommended that counsel's opinion be taken. Alderman Daw suggested that the surest and least expensive way of meeting the difficulty would be to refuse their sanction for the carrying of wires across the canal. This would unquestionably settle the matter. This suggestion for the solution of the question was received with laughter.

Electric Lighting in Belfast.—The premises of Messrs. Robinson & Cleaver, Donegall Place, Belfast, have been illuminated with the incandescent electric light, supplied by Messrs. Greenhill. The light which was equal to 70,000 C.P., was most brilliant, and the premises, to which the public were admitted, presented a very fine aspect. Several thousand persons visited the establishment during the evening, and large numbers witnessed the illumination from the street.

Electric Lighting Act Amendment.—Lord Thurlow's Electric Lighting Act Amendment Bill, which was checked in its progress through the House of Commons last week, passed safely through committee of the House on Monday night, with but slight alteration from the form in which it left the House of Lords.

Interruption to Theatre Lighting.—According to our contemporary *La Lumière Electrique* it would appear that the importance of the accident by which the electric lighting at the Chatelet and Opera Comique theatres was interrupted has been much exaggerated. It seems that owing to heated bearings in the Weyher and Richemond engines, one-half of the incandescence lighting failed on two occasions on the same evening. At the first extinction the lighting was immediately resumed by means of a spare machine; this, however, also became incapacitated from the same cause, and half the incandescence lighting was extinguished, but was partly replaced by gas.

Bradford Electric Lighting.—At the monthly meeting of the Bradford Town Council held on Tuesday last, a communication was read from the Local Government Board giving authority to borrow £20,000 for electric lighting purposes. Alderman F. Priestman then moved resolutions accepting the tender of Messrs. J. & W. Beauland for excavating, brickwork, ironfounder and smith's work, masonry, carpentering, joinery, plumbing, glazing, &c., in connection with the electric lighting works for £3,690; the tender of Messrs. Holdsworth & Sons for the supply and fixing of three mild-steel boilers and fittings for £2,125; and the tender of Messrs. Siemens Brothers & Co., Limited, for the supply and fixing of dynamos and all the appliances for £12,543; the total cost of the proposed installation being £18,358. Further, the committee recommended that the Council should authorise the Gas Supply Committee to apply to the Local Government Board for authority to increase the sum to be borrowed for electricity works to an amount not exceeding in the whole £25,000. Messrs. Siemens & Co. were providing the whole of the electric appliances, including the dynamos and fittings, and were to superintend and manage the works for a period of six or eight weeks after the latter were completed. The total amount of the tenders came to £18,358. To that they must add £2,000 for contingencies, and that brought the total up to over £20,000. The small balance of £5,000 would be required for the carrying on of that important work. The reason why they were asking for more money was that the installation was to cover a somewhat larger area than that which had been proposed in the first instance, and further, because the works were to be of a permanent, and not of an experimental character. The committee had felt convinced that to put down an installation of less than 3,000 incandescent lamps of 16 candle-power each would not give a fair test or proof of the success of this undertaking, and it was that reason which had induced them to bring before the Council that resolution. Mr. David Barker seconded the resolution. Mr. Galloway spoke against the resolution. He said that when the scheme was first mooted the cost was to be from £10,000 to £12,000. He would like the matter to be referred back to the committee for consideration; but if the chairman was determined to go on with it, then he ought not to exceed the £20,000. The minutes were adopted, with two dissentient votes.

Ship Lighting.—H.M.S. *Medea*, a twin-screw, second-class steamer, successfully launched at Chatham last Saturday, is lighted throughout by electricity, and will be furnished with three powerful search lights.

Last week Messrs. S. McKnight & Co., Ayr, launched a beautifully modelled screw steam yacht, which on entering the water was named *Tighnamard*. In addition to the usual handsome fittings, Messrs. Patterson and Cooper will furnish a complete installation of the electric light.

On Wednesday evening, at the invitation of Messrs. J. H. Holmes & Co., a number of gentlemen interested in electric lighting visited the *Inanda* in the London Docks, and inspected the installation, a description of which we gave last week. The dynamo is a Holmes's "Castle," the engine Tangye's latest form of the "Archer," and the lamps employed on deck are the "Sunbeam." The work appears to have been executed in the most efficient manner, and everything possible has been done to render the arrangements easy to manipulate, and free from liability to get out of order.

In connection with the electric lighting of the Queen's yacht *Victoria and Albert*, which is being carried out by the Admiralty, Messrs. Drake & Gorham have received instructions to supply 40 of their largest type of ship-lighting cells; also a special switchboard fitted with their patent ring contact switches. The accumulators are to be placed in a special cabin on deck.

Domestic Electric Lighting.—Mr. W. Abercrombie has decided to light the new house which he is building at Brooklands by means of the electric light throughout. The power is to be obtained from an Otto gas engine driving an Elwell-Parker dynamo. The installation is in the hands of Messrs. Drake and Gorham.

Telegraphic Convention with France.—Mr. Vincent asked the Postmaster-General last week whether, before the terms of any convention between the Government and the French Republic were finally agreed upon, every effort would be made to provide for the reduction of the cost of messages to the combined inland rates of both countries after the purchase money had been recouped, and that in the meantime it should not exceed the combined rate of 1d. per word by more than ½d., having regard to the large commercial interests affected, and also to the fact that submarine telegraphy over the longer distance between Great Britain and Ireland or the Channel Islands involved no advance on the British inland rate, and that the charge between France and Algeria was only 1d. per word. Mr. Raikes replied that while no extra charge is made upon inland messages passing over the cables between Great Britain and Ireland and Great Britain and the Channel Islands, there is no question that the maintenance of those cables involves a considerable yearly loss. The negotiations with the French Government are still proceeding, and he could at the present time only say that he hoped a substantial reduction in the present charge for messages passing between this country and France would be made.

Telegraphic Communication with France.—In his capacity of President of the British Chamber of Commerce in Paris, Mr. Edward Blount has addressed to Mr. Raikes, Postmaster-General, a letter relative to the telegraphic communication between England and France. Mr. Blount argues that the system now generally adopted as regards postal and telegraphic communications is to make them as cheap as possible, and in international cases not to allow them to exceed the combined inland rates of both countries. But the public and the postal administrations are, as a general rule, benefited by the adoption of cheaper tariffs—the public by the increased facilities given them, the post offices by the increase in the number of communications, which have generally, from a financial point of view, more than compensated the reductions made in the charges. The reduction proposed by the French Administration of from 2½d. to 2d. per word is obviously insufficient largely to increase the telegraphic traffic between England and France, and consequently it would not financially have the usual result, but there would be no exception to the general rule if a liberal reduction—say to 1d., or, if needs must be, 1½ per word, were adopted.

The Police Telegraph System.—Since the riots which took place in the West End and the meetings of the unemployed in Trafalgar Square the attention of the authorities has been directed to the perfection and extension of the police telegraph system throughout the metropolis. The result has been that during the last few months London has been intersected by a network of wires for the special use of the metropolitan police, and under the present conditions the concentration of a large body of police officers in any part of London on the shortest notice would be a comparatively easy matter. The system has been carried out on an extensive scale. The central police offices are also connected by either telegraph or telephone with the Fire Brigade stations, the War Office, the Home Office, the House of Commons, and the House of Lords, as well as with the private residences of the superior officers. In addition to these extensions, in case of emergency a message handed in at any postal telegraph office by a police officer is to take precedence of any others.

Automatic Machines.—The Nightingale Automatic Electrical Machine Company, Limited, has placed an order for 500 machines with the Vulcan Manufacturing Company, electrical engineers, Islington, N.

The Society of Telegraph-Engineers and Electricians Students' Meeting.—On the 7th of June, Prof. Perry, M.E., D.Sc., F.R.S., in the chair, the following paper was read:—"Belts and Belt Driving," by J. N. Cooper. A discussion followed, in which Messrs. Marsh, Paul, Lamb, Mitchell, Sanders, McMahon, Poynton, Rance, Allam, Hume and Shephard took part. A vote of thanks to the chairman terminated the proceedings.

Brighton Electric Railway.—A special meeting of the Brighton Town Council was held on Wednesday to consider a report from the Works Committee recommending that Mr. Volk, the proprietor of the electric railway running from the Aquarium to Paston Place groyne, be required to remove his plant. The council having recently approved a scheme for the development of the Madeira Road, it was moved that the provisional assent given for the experimental construction of this railway should now be withdrawn. The motion was rejected by 21 votes against 7.

Electrically Propelled Cab.—The *Court Journal* states that a six-ton cab, carrying an electric battery of force sufficient to propel it forty miles without renewal, recently made a satisfactory trip through the streets.

The Royal Society.—The following gentlemen have been elected into the Society:—Thomas Andrews, F.R.S.E., James Thomson Bottomley, M.A., Charles Vernon Boys, Arthur Herbert Church, M.A., Prof. Alfred George Greenhill, M.A., Lieutenant-General Sir William F. D. Jervois, R.E., Prof. Charles Lapworth, LL.D., Prof. T. Jeffery Parker, Prof. John Henry Poynting, M.A., Prof. William Ramsay, Ph.D., Thomas Pridgin Teale, F.R.C.S., William Topley, F.G.S., Henry Trimen, M.B., Prof. Henry Marshall Ward, M.A., and William Henry White, M.I.C.E.

Amongst the papers to be read yesterday were the following:—Dr. Gore, F.R.S. (1) "The Minimum Point of Change of Potential of a Voltaic Couple." (2) "On the Change of Potential of a Voltaic Couple by Variation of Strength of its Liquid." (3) "Influence of the Chemical Energy of Electrolytes upon the Minimum Point and Change of Potential of a Voltaic Couple in Water." Prof. J. C. Ewart. "The Electric Organ of the Skate. The Structure and Development of the Electric Organ of *Raia radiata*."

Technical Education.—Dr. Gladstone, F.R.S., in giving evidence before a special committee of the London School Board, submitted the following statement:—"Professor Silvanus Thompson told me that the only elementary school in London from which the Finsbury College could draw youths qualified for the technical classes was that of St. Thomas Charterhouse, where a good deal of scientific instruction is given and the boys are encouraged to make their own apparatus." Mr. Edward Bond, Assistant Charity Commissioner, instanced only three primary schools in England, viz., the higher primary schools of Manchester and Sheffield and St. Thomas Charterhouse, London, as giving an education calculated to develop intelligent artisans. Considering what is spent on education in this country, better results ought fairly to be expected.

Institute of Medical Electricity, Limited.—The first ordinary general meeting was held at Essex Hall, Essex Street, W.C., on the 7th inst. Mr. W. Lant Carpenter was voted to the chair. He explained that though the meeting was called in accordance with the requirements of the statute, the directors had but little to report, since they had been obliged to delay the opening of an establishment in London. This was mainly owing to certain negotiations with the Royal College of Physicians (which he hoped, however, would soon be satisfactorily completed), having reference to the appointment of medical officers to the institute. The directors had given considerable attention to the business of the institute, having held 16 meetings since the company was registered. Mr. F. L. Rawson, M.S.T.E. & E., had joined the board, and it had been unanimously decided that no directors' fees would be accepted until a dividend of 6 per cent. per annum should have been declared. The meeting cordially approved the action of the directors with reference to the Royal College of Physicians, and a resolution was passed confirming an agreement provisionally entered into by the board, whereby the institute acquires the business of the Electrified Rooms Company, of Southsea. This had been carried on for more than a year, with the warm approval and support of above 40 local medical men, upon a similar principle to that adopted by this institute, viz., that no electrical treatment is administered to any patient without the concurrence, and upon the prescription, either of his own medical man or of the medical officer of the institute.

The School of Electrical Engineering.—The managers of this school have just appointed Mr. Charles Capito, M.I.M.E., and M.S.T.E. & E., to the post of senior instructor, soon to be vacant by the resignation of Mr. Henry D. Wilkinson. Mr. Capito was for three years apprenticed to mechanical engineering works in Copenhagen, and studied for seven years in the Polytechnical Academy there, passing all the examinations with the highest honours. He then went to Greenland as a consulting engineer to the Kryolite Mining and Trading Company. He came to England (where he has since resided) in 1880, and for about two years held office in the City and Guilds of London Institute at Finsbury, under Prof. Ayrton, where several men now well known in the electrical world were his pupils. From this he became chief electrician to the Electrical Power Storage Company, whose employment he left because he desired to go into business for himself as a consulting engineer. He has however always had a strong desire to take up high class teaching again, and much regrets the day that he left the Finsbury college. His extensive practical experience, combined with thorough theoretical knowledge, ought to make him a valuable officer of the school.

China Fittings.—Messrs. Appleton, Burbey and Williamson have issued a list of switches, fuses, ceiling roses and lamp holders in china and other materials.

Phœnix Fire Office Rules.—These rules for electric light installations have now reached a thirteenth edition, a fact upon which the author, Mr. Musgrave Heaphy, is to be congratulated.

The Riddings Gas Bill.—This Bill on Monday came before the unopposed Committee of the House of Lords, the Duke of Buckingham presiding. The object of the Bill is to incorporate a company, with power to purchase the gas undertaking of James Oaks & Co., to authorise the supply of gas within certain limits, the construction and maintenance of gas works, the supply of electricity for lighting or heating purposes or for motive power, and other purposes. The Bill proposes to authorise a share capital of £30,000, and borrowing power £7,500. It was explained in reference to the clause relating to electricity that it was not proposed that the company should supply electric lighting, but to take power to apply to the Board of Trade for provisional orders to supply the light in case any large works wished to be supplied. The clauses of the Bill having been gone through formally, the Bill was allowed to pass the Committee stage, and will, in due course, be reported for third reading.

Cheap Fuse Plugs.—Messrs. Royce & Co., of Manchester, are producing a slate base fuse plug with metal removable cover, which is very simple in design and construction, and is offered at an exceptionally low price.

Somzée Accumulators.—According to *Industries*' Brussels correspondent, Somzée accumulators are finding a very good sale for private house lighting, and they are also being used for part of the electric lighting of the Exhibition.

Capital Punishment by Electricity.—New York is the first American State to substitute death by electricity for hanging. The Governor has signed the Bill passed by the Legislature making the change after January 1st next apply to all crimes committed on and after that date. The new law is the outcome of the following recommendation by the Governor in 1885:—"The present mode of executing criminals by hanging has come down to us from the Dark Ages, and it may well be questioned whether the science of the present day cannot provide means for taking the lives of such as are condemned to die in a less barbarous manner. I commend this suggestion to the consideration of the Legislature." The attention of scientific men was attracted to the subject by this message. In 1886 a Commission was appointed by the Legislature to investigate and report upon the most humane and practical method of carrying into effect the sentence of death in capital cases.

NEW COMPANIES REGISTERED.

Luther Hanson and Company, Limited.—Capital £7,500, divided into 900 ordinary and 600 deferred shares of £5 each. Objects:—To acquire from Messrs. Luther Hanson and Charles, of North Bridge Electrical Works, New Bank, Halifax, the following letters patent, viz.: (1) Improvements in arc lamps, No. 8,758, 5th July, 1886; (2) Improvements in field magnets, No. 10,240, 22nd July, 1887; (3) Improvements in dynamo electric machines or motors, No. 4,425, March 22nd, 1888. Signatories: *Joseph Longbottom, Luddenden Foot; *L. Ingham, Salterhebble; *G. Charnwick, Halifax, 20 shares each. *Luther Hanson, Halifax, 100 shares; C. Dobson, Halifax, 3 shares; J. R. Farrar, Halifax, 1 share; J. Duff, Halifax, 1. The signatories denoted by an asterisk are the first directors. Registered office at the offices of Mr. James Duff, Barum House, Barum Top, Halifax. Registered 6th inst. by Richard Jordan, registration agent, 120 Chancery Lane.

Petroleum Engine Company of America, Limited.—Capital £150,000, in £5 shares. Objects:—To acquire certain American patents relating to petroleum engines upon terms of an agreement between J. J. Revely Humes and Ernest Whitehead, and to carry on in the United States and elsewhere the business of mechanical and chemical engineers, manufacturers of engines, and workers and dealers in electricity, motive power and light, and any business in which electricity or any other power is useful, convenient, or ornamental. Signatories (with 1 share each), T. T. Curtis, 17, Triangle, Old Kent Road; G. F. Adams, 152, Fairbridge Road, N.; H. F. Adams, 126, Bayham Street, N.W.; W. Micklethwait, 34, Millman Street, W.C.; C. Chilcott, 39, Frederick Street, Caledonian Road, N.; G. F. Tucker, 30, Kerrett Road, Brixton; E. Whitehead, 73A, Queen Victoria Street. The first directors are the Duke of Manchester, Sir Hy. Cartwright, Major Alexander H. Ross, M.P., Major-General W. O. Swanston, Messrs. Wm. Tipping, R. O. Ritchie, and Joshua Priestman. Qualification, 40 shares. Remuneration, £200 per annum each, with an additional £100 per annum for the chairman. Registered 6th inst. by Messrs. Maddisons, 20, King's Arms Yard.

Automatic Electrical Corporation, Limited.—Capital £75,000, in £20 shares. Objects:—To act as undertakers for the supply of electricity for lighting and other purposes within the United Kingdom and elsewhere. Signatories (with 1 share each), E. J. Hermandez, 7, Liverpool Street; T. G. Kostzenstein, 27, Phillimore Place, Kensington; J. F. Blanchard, 25, Huntley Street, Tottenham Court Road; W. Doherty, 6, Great Newport Street; E. Guitton, C.E., 8, Canning Place; R. G. Upton, Mitcham; W. Sherratt, 461, Oxford Street. The signatories are to nominate the first directors. Qualification, £250 in shares. The company in general meeting will determine remuneration. Registered 7th inst. by Ashurst Morris, Crisp & Co., 6, Old Jewry. Registered office, Winchester House, Old Broad Street.

International Engineering Company, Limited—Capital: £5,000 in £1 shares. Objects: To acquire inventions of Wm. Danton Sandwell relating to electric motors and to means for carrying electrical batteries for driving tramway vehicles and other purposes. Signatories (with 1 share each): J. Drage, 26, Osborne Terrace, Clapham Road; E. A. Rider, 8, Lugard Road, Peckham; W. B. Pattisson, 52, Lincoln's Inn Fields; J. H. Yates, 63, Frith Street, W.; J. L. Hoffman, New Barnet; W. Davis, 480, Edgware Road. The signatories are to appoint the first directors. Qualification: £100 in shares. Registered 12th inst. by Hores and Pattisson, 52, Lincoln's Inn Fields.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Siemens Brothers & Company, Limited.—The annual return of this company made up to the 5th inst. was filed on the same day. The nominal capital is £500,000 in £100 shares. The whole of the shares are taken up, and £85 per share has been called and paid thereon. The calls paid amount to £425,000.

Incandescent Electric Lighting Company, Limited.—The returns of this company for 1887 and 1888 were filed on the 7th inst. The nominal capital is £250,000 in 50,000 shares of £5 each, and although the company is now in its sixth year, only eight shares have been taken up and upon these no call has been made. Registered office, Cambridge Street Works, Birmingham.

Bournemouth Electric Light and Power Company, Limited.—The registered office of this company is now situate at Richmond Chambers, Bournemouth.

Hastings and St. Leonard's-on-Sea Electric Light Company, Limited.—The annual return of this company made up to the 5th inst. was filed on the 9th inst. The nominal capital is £50,000 in £10 shares. 850 shares are taken, of which 167 are considered as fully paid. Upon 683 shares the full amount has been called, the calls paid amounting to £6,785 and unpaid to £45.

LEGAL.

Avery v. The National Company for the Distribution of Electricity by Secondary Generators.—(Before Mr. Baron Huddleston and Mr. Justice Charles.)—This was an application for a new trial, the case having been tried before Mr. Justice Mathew on the 10th and reported in the ELECTRICAL REVIEW on the 13th of April last, the result being a verdict for the defendants. It was an action to recover £250 lent to the company, and to register the plaintiff as holder of 200 preference and 100 ordinary shares, the plaintiff being a creditor and administrator of one Le Fez, a Frenchman, resident in London, and a director of the company, and who, at the time of his death, was credited with the £250 as lent by him, and appeared on the register as holder of the shares sued for. On the 15th of October, 1884, he wrote a letter to the directors authorising them to transfer the shares into the name of a French lady—the Countess de Rocquigny—and also assigning to her the debt due to him from the company, and on the 16th of October he committed suicide. A will dated the 15th of October, which was made according to French law, was proved in Paris, and did not mention the money or the shares. The letter being found after his death, the countess claimed the shares and the money as hers, bought with her money and lent out of her money, and the directors eventually, in February, 1885, recognised her claim and transferred the money and the shares to her; and in this action the company set up her claim in answer to the action, and their case was that on the 14th of October, the day before Le Fez made his will, she had demanded the money and shares as really hers and he had written the letter in consequence, and then, on the 16th, committed suicide. The learned judge left to the jury whether Le Fez, before his death, had acknowledged that he had the shares for the countess; if so, he was trustee for her. The jury found for the company—that is, virtually in "favour of" the countess, and this was an application on the part of the plaintiff, the creditor and administrator, to set aside the verdict as against the evidence; at all events as to the £250, and that the judge, having directed the jury that Le Fez held the shares in trust for the countess, this was a misdirection.

Mr. Crispe (with Mr. Ellis) on the part of the plaintiff admitted that there was a case as to the shares (if the letter was to be considered as that of a rational man), but insisted that there was no case as to the money lent. But there was nothing more than a mere authority to the company to pay the countess; not communicated to her, and so not amounting to an assignment, and revoked by the death of Le Fez.

Mr. Muir Mackenzie, for the company, urged that they could only set up the claim of the countess, to which, after enquiry, they had assented. Their case was that the shares and the money belonged to the countess, and that question was left to the jury.

After a long argument, which occupied a great part of two days, The Court came to the conclusion on Friday that the verdict was right and must be upheld.

The United Telephone Company, Limited, v. Tasker, Son and Company.—(Before Mr. Justice Kay).—This was a motion by the plaintiffs for an interim injunction to restrain the defendants, who are proprietors of a telephone exchange at Sheffield, from infringing the plaintiffs' patent for telephone transmitters and receivers. Mr. Aston, Q.C., Mr. Moulton, Q.C., and Mr. Micklem appeared for the plaintiffs; and Mr. Ince, Q.C., and Mr. Bousfield for the defendants. Mr. Justice Kay said that in this case the defendants admitted they were using telephones which were an infringement of the patent granted to the plaintiffs' predecessors in title in 1876, which patent now belonged to the plaintiffs. The making of those telephones and the use of them constituted an infringement of the plaintiffs' patent, and were a continuing wrong. The defendants, though admitting the user and admitting the infringement, justified their conduct in the following way. They said that they had formed an exchange in Sheffield; that they had done this at the invitation of the plaintiffs' predecessors in title, and under an agreement subject to which the patent was transferred to the plaintiffs. The plaintiffs now refused to carry out the agreement, and refused to supply the defendants with telephones at all; so the defendants made telephones, which they admitted were an infringement of the plaintiffs' patent. Now, as his lordship remarked in the course of the argument, suppose an agreement whereby a man agreed to pay a sum of money out of a particular balance at his bankers, and suppose a flagrant breach of that agreement, would that authorise the person wronged to forge a cheque to get the money? The defendants, by their conduct, were taking the law into their own hands; because the contract had been broken the defendants took upon themselves to infringe this patent. Their defence was no justification of the infringement; at the same time it was suggested that the contract under which the exchange in Sheffield was formed had been broken in a flagrant manner, though that was, in fact, denied. Then it was said that the plaintiffs had set up a rival exchange in Sheffield, and that their main purpose was to destroy the defendants' exchange. His lordship expressed no opinion as to that suggestion, but to set it aside entirely the plaintiffs now undertook, till the trial, to replace the telephones of the defendants, which were an infringement of the patent, by telephones of their own, which they might either lend, sell, or let for hire, so that the defendants' exchange might not be brought to an end or seriously injured. Upon these terms his lordship granted an injunction, until the trial or further order, to restrain the defendants, their servants, and agents, from making, using, selling, or otherwise disposing of any telephones which were an infringement of the plaintiffs' patent, the plaintiffs undertaking to supply to the defendants upon the usual terms as to cost, either by way of loan, sale, or letting for hire, at their pleasure, so many telephones as the order would prevent the defendants from using, the plaintiffs also giving the usual undertaking in damages.

Morgan v. Prichett.—(Before Mr. Justice North, June 1st.)—The plaintiffs in this action were two ladies, the owners of two houses in Hanway Place, Oxford Street, which are let in flats to weekly tenants, and two of their tenants. The defendants are Messrs. Prichett, who supply, from premises adjoining, electric light to the neighbourhood. The plaintiffs complain that the engines and dynamos of the defendants have been so worked as to produce a nuisance to the tenants, who all occupy the premises as dwellings, by reason of the noise and vibration. The plaintiffs seek an injunction to restrain the defendants from working their machines so as to be a nuisance. The action was now brought on on notice for an interlocutory injunction. There was some conflict of evidence, but the parties were agreed that on a certain occasion, on the evening of the 14th ult., when representatives of both sides were present on the plaintiffs' premises, the works were being carried on so that no substantial nuisance existed. It was stated, in answer to the Judge, by counsel for the defendants, that there was record in the defendants' office that their tension meter indicated at that time a pressure of from 100 to 105 volts, and that of the two steam engines employed by the defendants the smaller was governed to work at, and did on that occasion work at, the speed of 180 revolutions a minute, and the larger one at the speed of 120 revolutions a minute; and he offered to give an undertaking on behalf of the defendants to keep the working within those limits till the trial. His lordship said that one of the defendants' witnesses cognisant of the matter must make an affidavit as to the conditions of the working during the three-quarters of an hour in question, and the defendants must undertake to work within the limits of such conditions.

CITY NOTES, REPORTS, MEETINGS, &c.

The Western Counties and South Wales Telephone Company, Limited.

THE third annual ordinary general meeting of the above company was held on Thursday, the 7th inst., at the Royal Hotel, College Green. Mr. Chas. Nash presided. An abstract of the report of the directors appeared in our last issue.

The Chairman moved the adoption of the report and accounts, with the exception of that portion which referred to the creation of the additional capital, the consideration of which would be deferred until July. Having drawn attention to the increased business of the company, the chairman pointed out that there was an increase of no less than 84 per cent., and a large proportion of this wire extension was on trunk lines, chiefly in South Wales, where there was a very important territory, which it was desirable they should occupy as soon as possible. The cost of trunk lines had been nearly £19,000, and the rentals were at first very small, so that this outlay had been nearly unremunerative, and at the same time there had been interest to pay. But already the trunk income was coming in rapidly, and amounted now to about £1,300. The total trunk calls now amounted to very nearly 10,000 a month. In September when the trunk system was first set going the calls were something over 5,000, and now they were nearly 10,000. Their longest line at present was that from Bath to Llanelly, a distance of about 142 miles, and generally speaking the messages were satisfactorily heard. He had spoken of the importance of occupying South Wales ground, and this was made evident by the rapid growth of business there. What he said would, he thought, help to explain that the directors did not think it wise to recommend a divided on the ordinary shares. The balance would have admitted of a small dividend, but the directors, although confident of the future, advised carrying the balance to next year, making up the reserve fund to a round sum of £1,000. The general business grew rapidly, and very few weeks passed without some special suggestion. They would notice a desire had been expressed to connect London and Birmingham with the trunk wires and the system generally. These were important suggestions, but they could not be attempted without much consideration. Their experience showed there was a very great indirect advantage from trunk wires, not merely from subscribers and trunk calls, but by adding very materially to the exchange subscribers in the various towns. During the year trunk and renters' wires had increased to the number of 977 miles. One interesting extension they were looking forward to, and that was a proposal to connect Eddystone Lighthouse with Plymouth. This was not only desired by the Admiralty as giving an opportunity of connecting the dockyards with the lighthouse, but it would be of great use to the mercantile marine as a signal station to the ships passing. If they could see their way to a fair return on the outlay, he thought this extension might very soon be carried out. He would mention that there was a desire that the coastguard stations, and possibly some of the lifeboat stations, should be connected. At present they could not see where the income would be derived in order to meet the large expenditure which would be incurred, but if a connection was necessary the telephone was by far the best medium which could be utilised.

Mr. Mark Whitwell seconded the motion, and said he supported the remarks of the chairman, having a thorough belief in the financial success of the undertaking. A great deal had been done during the past year in the way of preparing for future work. People in England generally were only just beginning to wake up to the importance of the telephone, and he was sure the desire for its use would not only increase year by year, but month by month.

Mr. Richard Cory supported the resolution, and remarked that there was a great future for the telephone.

The resolution was adopted.

On the motion of the Chairman, seconded by Mr. J. B. Morgan, it was resolved that a dividend of 6 per cent. be paid to preference shareholders.

The retiring directors, Mr. Charles Nash and Mr. Richard Cory, were re-elected.

On the motion of Mr. Morgan a vote of thanks was accorded the retiring auditors, Messrs. Tribe, Clark & Co., for their services in the past, and Messrs. Hudson Smith & Co. were appointed for the ensuing year.

The proceedings shortly after terminated.

French Telegraph Company.

THE annual meeting of shareholders of the French Telegraph Company (Paris to New York) was held in Paris, M. Brueyre-Dellorier in the chair.

After the chairman had taken his seat there were complaints made by the representatives of several financial companies—the Société Général and the Credit Financier, &c.—that their right of attendance had been contested on this occasion, although not previously.

The Chairman explained that it had been done in error, and they had since done their best to put matters right.

M. Sordier complained of the outpayments which had to be made to foreign companies, which was not the case when there was an understanding with the English companies, and he urged the company to come back to it. £40,000 was now taken out of their total earnings of £68,000. If the law suit should be lost they would have to pay some 7,000,000 francs or 8,000,000, francs and if they had to pay that and go on paying out £40,000 every year what would be the end? In 12 years the cable would be worn out. The directors were only instruments of Mackay, and they were his victims. Mackay had made a large fortune, but he was now seeking to make something out of the French shareholders. The directors had been helped in all this by M. Granet.

The Chairman interposed. He could not allow M. Granet to be attacked. He had been a Minister, and was supported when the English agreement was broken off by M. Peytrail, who considered that what M. Granet had done was quite right.

M. Sordier said M. Granet had ruined them. He would ask for an indemnity from the Government, who ought to repay the company for their losses. He proposed to present a petition to the Deputies, which he hoped the other shareholders present would sign; if not he would prepare it and send it himself to endeavour to get back their money. He had bought his shares at 150 francs. Look at their price to-day!

The meeting here was very excited, and the chairman had to reply to desultory questions from all parts of the room. The shareholders did not rise, but spoke from their seats.

The Chairman could not say what their position would be if they lost their lawsuit. They could not re-enter the common purse. It was difficult to suppose they could lose it. The action taken by two Ministers was in conformity with their articles of association, and it was difficult to see how the Conseil de Prefecture could upset what had been done. The war of rates had been the cause of all their trouble. He had himself been always against it. They were bound hand and foot and could not do otherwise than they had done. If they lost their suit they had, perhaps, other means of getting advantages. They might join in the Antilles business, or with the General Telephone Company. When the Antilles scheme came forward some time ago their own shares rose some 50 francs or 60 francs. He was asked whether they had power to deal with any of these companies. He could only say they could only do so if they were free from their law suit. Within two months they hoped to have the decision of the Conseil de Préfecture, and they were pushing matters on with all their might. They could do nothing with their legs tied; but as soon as they were free they would be able to swim. They had accomplished a tour de force in getting the last judgment; they hoped by another tour de force to get a final decision in their favour, and that within three months.

M. Despecher said he did not generally take part in these meetings; but he would like to hear some explanations as to what these outpayments were, and to whom they were made—that was the £40,000 paid to foreign companies.

M. de Belleville, in answering, said he must first do full justice to the English companies, who had done their best to facilitate the course of the law suit, and had put no obstacles in the way. The cause of the outpayments was the sums they had to pay to the land lines in America. When they received, say, 30 francs for a message, they had to pay out 45 francs for it, which was 15 francs loss. Again, one word was allowed for an address; but in America they insisted on three being paid for. They had to ask the Government to allow them to refuse messages for the Antilles and South America on account of the outpayments. Since the rupture of the agreement they had met with great hostility from the land lines of America.

M. Despecher said as 70 per cent. of the traffic was with New York, it did not seem to account for the large total of outpayments. Was any portion of the sum paid to the Commercial Cable Company?

M. Belleville: Certainly not.

The report was put and adopted, after which the retiring directors were re-elected, and the proceedings closed.

Consolidated Telephone Construction and Maintenance Company, Limited.

The seventh annual ordinary meeting of the Consolidated Telephone Construction and Maintenance Company, Limited, was held at the Cannon Street Hotel on Friday last, Mr. C. L. W. Fitzgerald presiding.

The directors' report appeared in our last issue.

Mr. Ch. Curtoys, the Secretary, having read the notice convening the meeting,

The Chairman, in moving the adoption of the report, said the profits for the year were £10,788, which, with the balance from last year, amounted to £12,484. It was proposed to write off machinery plant account £541, and a further sum of £2,000 off investments in telephone companies, in addition to paying a further dividend of £2 17s., making with the interim dividend a dividend for the year of £5 7s. One considerable item of expense this year was an amount of £952 1s. 10d. which had to be paid as arrear of fees and special remuneration to Colonel Gouraud, who brought an action to recover it from the company. He regretted that Colonel Gouraud had now thought fit to bring an action for libel, said to have been contained in the reports to the shareholders. They were, however, advised that the reports were privileged. But apart from that they had no idea of libelling Colonel Gouraud. All they did was to show to the shareholders what they found in the minute books. The negotiations in Portugal had been satisfactorily terminated, with the result that a very favourable concession had been made to the Anglo-Portuguese Telephone Company, and he hoped it would be a source of profit to this company. The manufacture of instruments by the company itself, and not through a contractor, had resulted very favourably, and he believed they would make considerably more profit. He also looked for an increase of telephone business to the proposed fusion of all the companies in the country. If people could communicate from town to town it would greatly popularise the telephone. In conclusion, he congratulated the meeting that the subsidiary companies, the Telephone Company of Austria and the Anglo-Portuguese Company, had become money-making companies.

The report was adopted, and the dividend declared. Sir Alexander Armstrong and Mr. A. H. Baker were reappointed directors.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 8th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,606.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending June 8th amounted to £4,311.

NEW PATENTS—1888.

8039. "Improvements in or relating to the transformation or conversion of electric currents.'" A. Le Clercq and A. Vansteenkiste. Dated June 1.

8062. "A combined electrical time switch and electrometer." F. Kleiner. Dated June 1.

8081. "Improvements in and relating to electrical bells, indicators, and such like." W. Rowbotham and W. Fox. Dated June 4.

8099. "Improvements connected with electrical hoists or cranes." R. E. B. Crompton, J. F. Albright, and J. H. F. Soll. Dated June 4.

8160. "Production by electricity of chlorine and its oxygenated compounds, and their utilisation thereof." E. M. H. Andreoli. Dated June 4.

8161. "Bleaching paper pulp by electricity." C. C. Nichols and London Electric Bleaching Company. Dated June 4. (*Complete.*)

8170. Improvements in governing devices for electric motors and circuits." H. J. Allison. (Communicated by the Baxter Electric Manufacturing and Motor Company, Incorporated, United States.) Dated June 5. (*Complete.*)

8171. "Improvements in magneto-electric liquid level indicators." J. J. Ghegan. Dated June 5. (*Complete*)

8200. "Improvements in electrical transformers." W. T. Goolden and H. W. Ravenshaw. Dated June 5.

8354. "Improvements in the manufacture of depolarisers for primary or secondary electric batteries." M. Leclanche. Dated June 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

7021. "Improvements in electro-dynamic and dynamo-electric machines." G. Scarlett. Dated May 13. 8d. Has for its object an electro-motor that will work without field magnets. The claims are 3 in number.

7611. "Improvements in submarine cable grapnels, grapnel rope couplings, and connections." W. C. Johnson and S. E. Phillips. Dated May 25. 8d. Claims:—1. The method of connecting a grapnel rope to a submarine cable grapnel by passing the same through a longitudinal hollow formed in the shank of the grapnel, and securing it therein, substantially as described. 2. Constructing submarine cable grapnels with a longitudinal hollow in the shank for receiving the grapnel rope, the shank being either in one piece or divided for this purpose, substantially as described. 3. Constructing couplings for grapnel ropes, substantially as described.

8262. "Improvements in and pertaining to electric generators." W. M. Mordey. Dated June 8. 11d. The inventor constructs an improved form of field magnet which, with a single exciting coil or winding, supplies the whole inductive effect. In applying this invention to armatures of this general type he surrounds the whole periphery of the armature with iron. Inside the iron ring thus formed he places the magnetising coil or coils of wire or other suitable conductor, the convolutions of which also entirely surround the periphery of the armature; or the magnetising coil or coils may be at the side or sides of the armature near the periphery. From the outer iron ring pole pieces project inwards towards the axis of the armature, such pole pieces facing one another with the armature between them. Thus there are produced a number of similar magnetic poles on one side of the armature faced by a number of poles of opposite sign on the other side. The whole of these poles or polar projections are magnetised by the peripheral magnetising coil or winding. The claims are 11 in number.

9515. "Improved process and apparatus for tanning by aid of electricity." E. Worms and J. Bale. Dated July 5. 8d. Claims:—1. The described process for effecting rapid tanning of hides by subjecting them to the action of tanning liquor in a rotating drum while an electric current is passed through the contents of the drum. 2. For conducting the process above referred to, the construction of the drum with internal metallic rings connected electrically to external metallic rings against which bear springs connected by conductors to the terminals of a suitable electric generator, substantially as described.

13148. "An improved method of and apparatus for producing rectilinear or rotary motion by the aid of electricity, chiefly applicable to the regulation of electric currents." F. Ross and A. Franzen. Dated September 28. 6d. Claim:—The method of producing a rectilinear or rotary reciprocating movement by the described arrangement of grippers, in which the movement of the plate carrying the grippers may be produced by electro-magnets or solenoids.

13447. "Improvements in electric railways and tramways." A. L. Lineff and E. H. Bayley. Dated October 4. 1s. 3d. Relates to electric railways and tramways in which the energy of the current is conveyed through the whole of the working line, and the various converting apparatus (motors, lamps, and the like) are connected therewith in parallel arc. The main objects of the improvements are to minimise the leakage of the electric current in the process of distribution; to avoid the use of the more expensive metals for conductors; to prevent the wear and tear of the conductor in the process of collecting the current therefrom: to provide for cutting out of the circuit any part of the conductor for the purpose of repairs, without interrupting the action of the circuit; and also to provide for automatic signalling to regulate the traffic. The claims are 15 in number.

15056. "An improved multiple electric cable." J. A. Betts. Dated November 4. 8d. Claim:—The manufacture of a flat tape or ribbon-like multiple electric cable, composed of a warp of insulated conducting wires laid side by side alternately or not with non-conducting yarns, and a weft of non-conducting material interwoven with the warp, substantially as specified.

CORRESPONDENCE.

Static Electricity and the Incandescent Lamp.

The experiments described by Mr. Emmons under this head are chiefly interesting to electricians and people engaged in electric light work from the proofs they give that in the art of lamp-making the Edison factories, at least in the States, have yet much to learn. The interest of the first experiment seems to lie in the fact that a stick of glass when blown into a bulb has the same frictional properties as a plain stick of glass.

> "There needs no ghost come from the grave,
> Horatio, to tell us that."

By the other tests Mr. Emmons has succeeded to perfection in proving that the lamps in question were unfit to be put on the market. The vacuum in lamps which glow when rubbed by the hand, or when gently stirred in the barrel, must be exceedingly bad, probably not exceeding $\frac{1}{1000000}$th of an atmosphere. This is a sad falling off from the $\frac{1}{10000000}$th of an atmosphere talked of by Edison as attainable, and considerably discounts the celebrated claim for lamps exhausted as perfectly as possible.

Such lamps as Mr. Emmons describes will run at a low efficiency (possibly with considerable alteration in their resistance), developing a large amount of heat and rapidly blackening, while the life at normal brightness is likely to be short. A well exhausted lamp requires a fairly powerful induction coil or electrical machine to cause any visible glow in the lamp, while the condensing power is practically nil, the S.I.C. of a vacuum being inappreciable. If Mr. Emmons will repeat his experiments with a scientifically and carefully made lamp of good vacuum, such as the Woodhouse and Rawson lamp, he will find that no glow will be visible, except when in the immediate circuit of an induction coil. It will be advisable, however, to limit the length of spark employed in testing, as the potential required to discharge across the vacuum would be likely to pierce the glass, in which case the experimenter might receive a dangerous shock.

J. A. R. Milton.

June 13*th*, 1888.

Thunderstorms and Lightning Accidents.

As the season of thunderstorms and lightning accidents is now approaching, I hope you will kindly allow me to make known through your columns the fact that, in the interests of science, the Institute of Medical Electricity is very desirous of obtaining authentic information concerning lightning accidents, whether fatal or otherwise.

I should therefore esteem it a favour if some of the many friends of humanity among your readers will assist us to investigate these phenomena by sending me such particulars of accidents of this nature as they may have personal or reliable knowledge of, as soon after they occur as possible.

Of course, electrical and physiological details are what we most require, but reliable general information is often very valuable, and will be gratefully received.

H. Newman Lawrence, *A.S.T.E.&E.,*
Electrician to the Institute of Medical Electricity.

24, Regent Street, London, S.W.

Okonite.

Your note on page 614 of yesterday's ELECTRICAL REVIEW may give a wrong impression as to my tests of "okonite." The tests for insulation and capacity were made upon three samples, each of about 2,000 feet in length, and one sample of 300 feet in length.

The experiment on the length of 10 feet was confined to determining the effect of oil on the insulation, for which it was perfectly valid, as the purpose was not to determine whether the core was liable to local defects but whether or not oil had a deleterious effect on a piece of perfect core.

J. Hopkinson.

June 9*th*, 1888.

Galvanic Belts.

I am under a great obligation to you for kindly publishing the correspondence between Harness and myself with reference to my communication which appeared in the *Western Morning News*.

Perhaps you will permit me to respectfully inform the "eminent one" that his bombast, or superabundance of gas, will not cause my pulse to beat above the usual number per minute, and that he may confidently expect my abject apology for using the word "electropathic" as a generic and general term, at the same time that he succeeds in taking honours in the City and Guilds Exam. or lectures before the Soc. of Tel. Engineers and Electricians on the marvellous curative properties of his electropathic belt, which he says "generates a *mild* continuous current of electricity which speedily cures all disorders of the nervous system, stomach, liver, and kidneys."

Many a poor sufferer to whom Mr. Harness has proved a real benefactor by his *well-known treatment* must feel delighted in the extreme at the very high distinction conferred on him by the Belgian National Society—namely, the Cross of Merit. But I am inclined to think that the majority of your readers will take it for what it is worth. It all helps, no doubt, to make a pretty and imposing advertisement, like a clown's pantaloons.

Your correspondent, Mr. Beaumont, offers Mr. Harness a practical suggestion; but it has been, I think, pretty clearly proved that it is not the electrical resistance of the human body or the meaning of ohm or volt that is sought after by most of his class, but "disses" of a different colour from those attached to strips of flannel and sateen called a "galvanic belt."

Personally speaking, I consider Harness a foeman not worthy of one's steel, and therefore I will, with your kind permission, dismiss him with a caution.

The ball has been set rolling, and to all appearances its velocity increases, and I feel confident it will continue in motion until it has accomplished its benevolent ends.

J. Jerritt, *S.T.E.&E.*

Plymouth, *June* 11*th*, 1888.

Electric Traction.

I should have taken no further notice of the letters of William Brand, had he not by his last communication revealed his identity, and made further reference to my statement in the ELECTRICAL REVIEW of May 20th, "as to the engineering point there is little to consider." This statement I still adhere to, and William Brand does not show or prove anything to the contrary, not even by appealing to the editors.

These gentlemen were quite right when they stated that the report did not bear upon the "*engineering* or *commercial*" part of the question. Of course it did not, neither did it pretend to in a direct sense; it mainly, and I believe was intended solely, to deal with the *electrical* part. Engineers differ much in their opinion. I ascertained the views of three engineers upon the best kind of material to use for making the toothed pinions; one advised steel, another wrought iron, the third phosphor bronze. I did not take precisely the advice of any of them, but employed such a combination as seemed to be best suited, and practice thus far has proved the combination to be a very good one, employing as I do, vulcanised fibre for the teeth of the mortice wheels, and unless William Brand has had experience of the combination I employ previous to me, I do not see the value of his remarks. Practice alone will prove which plan of electric traction will stand commercially. As to William Brand's figures, they have about as much value in them as had Dr. Lardner's upon the inability of a steam ship to cross the Atlantic. I will now give William Brand a piece of advice—do not presume to treat upon the subject of "engineering" until you possess sufficient knowledge and confidence to enable you to stand your own footing without calling in the aid of the editors to try and support you in your imaginary contention.

A. J. Jarman.

June 13*th*, 1888.

[It was partly of the electrical data contained in the report to which Mr. Jarman alludes that we complained, but as the matter at issue is really so very slight, and as the discussion appears to be assuming a personal character, it is useless to extend the controversy any further.—EDS. ELEC. REV.]

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